UNIVERSITÉ D'ORLÉANS

ÉCOLE DOCTORALE SCIENCES DE L'HOMME ET DE LA SOCIETÉ

LABORATOIRE D'ÉCONOMIE D'ORLÉANS (LEO-UMR 7322)

THÈSE présentée par :

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soutenue le : **19 Mai 2015**

pour obtenir le grade de : **Docteur de l'université d'Orléans**

Discipline/Spécialité : **Sciences Économiques**

Financial Stability and Inflation Stabilization

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A ma Mère

Remerciements

Je tiens tout d'abord à remercier mes deux directeurs de thèse, Jean-Paul Pollin et Patrick Villieu, pour avoir accepté de diriger mes travaux de recherche au cours de ces années. Je leur exprime toute ma gratitude pour leur encadrement de qualité exceptionnelle, la rigueur dont ils ont fait preuve, leur grande disponibilité, mais aussi leurs précieux conseils qui m'ont permis de dépasser les difficultés ainsi que les périodes de doutes, et de mener à bien ce travail.

Je remercie Jean-Louis Combes et Valérie Mignon pour m'avoir fait l'honneur de rapporter cette thèse, ainsi que David Archer et Christian de Boissieu, pour avoir aimablement accepté de faire partie de mon jury de soutenance.

Au cours de ces trois années de thèse, j'ai eu l'opportunité d'effectuer deux stages de recherche dans des institutions internationales, et de collaborer sur des projets de recherches en dehors du milieu académique. A cet effet, je remercie tout d'abord Scott Roger pour son encadrement lors de mon stage au bureau européen du Fonds Monétaire International. Cette expérience a été particulièrement enrichissante. Je remercie ensuite Franck-Anthony Nganawara pour m'avoir donné l'opportunité de passer quelques mois au département de la recherche de la Banque Centrale des Etats de l'Afrique Centrale, dans le cadre d'un séjour de recherche. Je remercie enfin Christian Ebeke, avec qui j'ai eu beaucoup de plaisir à travailler et dont les conseils et l'amitié restent précieux.

Mes sincères remerciements à Remy Bazilier, Céline Colin et Aurélien Leroy, pour avoir pris de leur temps pour relire certaines parties de cette thèse. Pour leurs remarques très constructives sur mon travail, je remercie Sylvain Benoit, Gregory Levieuge, Yannick Lucotte et Alexandra Popescu. Je remercie également Nabila Boukef pour son assistance concernant la mise en page de ce document.

Le Laboratoire d'Economie d'Orléans m'a permis de travailler dans des conditions excellentes et au sein d'une équipe de recherche très dynamique. Je remercie notamment les enseignants dont j'ai assuré les travaux dirigés (Raphaëlle Bellando, Sébastien Galanti et Gregory Levieuge) ainsi que le personnel administratif (Caroline, Cécile, Collète, René-Hélène et Solange). Mention spéciale pour la grande et chaleureuse équipe des doctorants (et anciens doctorants) du LEO qui a rendu ces années de thèse très agréable. Abdellah, Angela (et Ben), Arslan, Asma, Aurélien, Christian, Cristina, Désiré, Eric, Fadi, Florian, Hadi, Ismaël, Leila, Leonardo, Marie-Pierre, Maxime, Muhammad, Nabila, Nicolas, Noaman, Olivia, Oana, Oumou, Robin, Sylvain, merci à tous pour votre soutien, votre amitié et tous ces moments que nous avons partagés ensemble.

Je remercie mes amis qui, chacun à sa manière, m'a soutenu depuis le début de cette thèse : Céline, Jean-Guillaume, Moussé, Patrick, Samba, Steve, Yannick, Yves. Je remercie affectueusement Ingrid pour ses tendres attentions.

Enfin, c'est avec le plus grand bonheur que j'exprime ma reconnaissance à ma famille qui malgré la distance a été présente à tout instant et dont le soutien reste ma principale source d'énergie. J'ai une pensée toute particulière pour ma mère dont l'amour, l'affection et le soutien sans faille m'ont toujours guidé. Je remercie également mon frère, Francis, et ma belle-sœur, Maguy, pour leur présence dans ma vie et tout ce qu'ils m'apportent.

Merci une fois de plus à tous.

List of acronyms

BCBS	Basel Committee on Banking Supervision
BoE	Bank of England
CPI	Consumption Price Index
DSGE	Dynamic Stochastic General Equilibrium
ECB	European Central Bank
EMEs	Emerging Markets Economies
ERR	Exchange Rate Regime
FED	Federal Reserve (U.S. central bank)
G7	Group of 7 - consists of the seven major advanced economies
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
ICRG	International Country Risk Guide
IFS	International Financial Statistics
IMF	International Monetary Fund
IT	Inflation Targeting
ITer(s)	Inflation Targeter(s) - Country which has adopted inflation targeting
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
PSM	Propensity Score Matching
U.K.	United Kingdoms
U.S.	United States of America
VAR	Vector Auto-Regressive
WDI	World Development Indicators
WEO	World Economic Outlook

Content

General Introduction

This Ph.D. dissertation is built upon the debate on the concern for financial stability in a context where the main monetary policy mandate is inflation stabilization. The 2008/2009 global financial crisis has revived this issue which is now among the key discussions at the forefront of the policy-making.

In this introduction, we start by briefly summarizing the evolution of the financial stability role of monetary policy. Next, we shed light on some weaknesses which have been underlined by the recent global financial shock, with regard to fiscal, monetary and prudential policies. Then, we discuss the main purpose and issues investigated in this work. And finally, the main building blocks of the thesis are sketched.

I. Evolution of the financial stability role of monetary policy

Historically, the monetary policy-making has been devoted to achieve general economic stability, including the stabilization of the financial sector. Central banks were required to set their policy in a way that is consistent with monetary stability but also a safe financial environment. As stated by Goodhart (2010), central banks have generally had three main functional roles. The first is to maintain price stability which is subject to the prevailing monetary policy regime (gold standard, pegged regimes, or inflation target). The second is to safeguard the stability of the financial system, and more broadly, to enhance financial development. Finally, the third function is to support the State’s financing needs during crisis periods, or rather constrain the misuse of the State’s financial power in normal times.

The extent to which monetary policy has been conducted with particular attention on those three objectives has however evolved in the central banking history, implying a shift between these goals over time. This work pays a particular attention on the financial stability function of central banks. This function has been originally important given the special position of central banks as lender of last resort for the banking system. Indeed, banks play a crucial role in the modern economy, through their intermediation activity which relates borrowers and lenders. This role of the banks entails credit evaluation and maturity transformation which may be subject to various forms of risk. Especially, one source of instability can emerge when banks are confronted to panics and runs, forcing them to liquidate their assets. In such conditions, the role of lender of last resort of the central bank is crucial to maintain the stability of the financial system by providing access to liquidity. The articulation of monetary policy consistently with a safe banking sector has been affected by regime changes.

It may be argued that the relation between monetary and financial stability was particularly evident under the gold standard. Monetary stability was to be maintained by ensuring the convertibility into gold which acted a nominal anchor for monetary policy. Financial institutions were however also required to be able to mobilize gold, or assets that can be easily convertible into gold, in order to meet their commitments. Therefore, the gold standard also acted as a financial anchor imposing some constraints on financial and credit expansion. Goodhart (1988) underlines two main functions of central banks at that time: a macro function related to monetary stability in the economy, and a micro function aiming to maintain the stability and the well-being of the financial system. The interwar period has been characterized by a gradual emergence of financial liberalism in which the banking system developed dynamic credit activities, given the breakdown of the convertibility system (and no effective anchor) and the (yet) limited financial regulation. This has led to increasing financial imbalances. This period has been particularly marked by the German hyperinflation and the great depression. This has subsequently motivated a more stringent banking system regulation, later in the 1930s.

Under the Bretton Woods system, the financial system appeared to be particularly stable (Icard, 2007). The policy regime was characterized by a de facto dollar standard, but also a monetary policy setting aiming to control credit aggregates and affect the interest rate. The more restrictive banking sector regulation prevailing during this period also contributed to strengthen the financial sector stability. However, it may be argued that such a regulatory framework imposed to financial institutions has had increasingly efficiency costs. The collapse of the Bretton Woods regime and the deregulation of the financial system have been followed by a transition period in the evolution of the monetary policy regime in the 1970s. Central banks move toward a new anchor, namely, monetary targets. This period was also characterized by relaxation of constraints on financial institutions, increasing deregulation, the emergence of free a market economy, and ultimately, higher financial instability. The precondition for an effective monetary target, which is the stability of the relationship between monetary aggregates and aggregate price (the final goal) appeared to have been weakened. Besides, the period from the mid-1970s to early 1980s was characterized by high levels of inflation (caused, among other factors, by the 1970s oil price shocks), pushing the monetary policy-making in a new era.

Following the success of disinflationary policies implemented by central banks in the early 1980s, monetary policy has been mainly characterized by two elements: price stabilization as the main objective of central banks (sometime with specific and precise inflation targets), and the short term interest rate as the main monetary policy instrument to achieve this goal.[1] The issue of financial stability has been largely left aside in the monetary policy-making, and potentially considered as a matter of concern only if financial imbalances affect the inflation objective. In such a framework, it was implicitly admitted that good achievements in terms of inflation stabilization also strengthen the financial sector stability.[2] The late 2000s global financial crisis has considerably challenged this view. Indeed, the crisis erupted in a context where the global economy navigated in very calm seas, characterized by unprecedented low and stable inflation. This good control of inflation was however associated with growing financial imbalances and increasing financial risks. As a consequence, discussions on the financial stability role of monetary policy have been revived, and to some extent, we are now rediscovering the role of monetary policy in insuring the stability of the financial system.

[1] This is discussed in more details in the first chapter.

[2] Or at least that financial stability concerns have to be managed by a (micro) prudential framework.

II. Flaws underlined by the recent crisis

The 2008/2009 financial crisis has had widespread effects on the financial sector in the first place, but also strong consequences on the real economic activity. Generally, in the years 2008 and 2009, financial conditions in the U.S. and the most industrialized and open economies were characterized by high instability and elevated stress. The impairments in the financial environment translated to the real economy, generating significant macroeconomic instability and huge macroeconomic imbalances. In response to those financial and macroeconomic consequences of the global financial shock, various policy actions have been undertaken, including fiscal policy measures and monetary policy interventions. Governments in most advanced economies reacted to support their banking sector by bailing out the most important and more fragile financial institutions (to avoid increasing default risks and bankruptcies). Given the severity and the persistence of the shock, governments also needed to deploy more important fiscal stimulus to support the economic activity and curb the downturn.[3] The immediate central banks' response to the crisis was to lower their policy interest rates in order to accommodate the shock and ease the financial institutions' refinancing conditions, but also to address deflationary risks. However, this traditional policy instrument soon reached its limit, as nominal interest rates attained the zero bound in many advanced economies. Unconventional monetary policies have therefore been deployed to continue to mitigate the effects of the crisis.

The late 2000s financial turmoil has revealed some weaknesses regarding the conventional wisdom which has prevailed thus far, in many aspects including fiscal policy, the prudential framework, and the monetary policy-making. Before the global financial shock and the subsequent sovereign crisis in Europe, it was thought that sovereign debt crises are more likely to primarily occur in emerging and developing countries. The financial and fiscal linkages seem also to have been understated. Especially, the crisis has revealed that headline fiscal surpluses can in fact hide important structural deficits during asset prices booms, and that contingent liabilities with respect to large domestic financial institutions (which are highly connected to the global financial system) can generate much more important debt

[3] Although those fiscal measures proved to have played a crucial role in dealing with the financial and real economic issues in the aftermath of the crisis, they have had side effects in terms of government debt sustainability, especially in Europe.

problems than recognized, when the risk materializes. More generally, in the pre-crisis period, less attention was paid to adverse feedback loops between financial (bank) risk and fiscal risk, which may yet be very important given the size of the banking sector in some countries. Considering those lessons learned from the crisis, the assessment of the fiscal position is now reconsidered. It appears to be relevant to be more cautious about the structural fiscal stance, and to take better account of the likelihood that some (financial) events can rapidly worsen the government debt sustainability.

Regarding the prudential framework, the increasing risks accumulation in the early 2000s has failed to be accurately mitigated by the existing regulatory system at that time. The risk stemmed from a large increase in the financial institutions and households leverage during the so called “great moderation”. As reported by the IMF statistics, compared to its level in the late 1980s, the financial institutions’ leverage has more than tripled in most advanced economies in 2007; while the households’ indebtedness increased by about 75% (IMF 2009 Global Financial Stability Report). The risk also originated from an important development of financial innovations, implying more sophisticated financial instruments which make it more difficult to assess the risk. In addition, financial globalization, deregulation, disintermediation, and increasing competition in the banking sector have certainly significantly contributed to increasing risk taking among those institutions. The prevailing prudential framework failed to contain those risks.

This framework was also mainly characterized by the micro level of the risk assessment, suggesting an analysis of financial risks at the individual financial institutions level. Besides, the control was mostly focused on banking and insurance, leaving aside others important and potentially risky financial institutions. Such a framework also failed to take account of the interconnections between financial institutions, and between the financial sector and the real economy. As stated by Rajan (2005), the modern financial system is characterized by more pronounced linkages between markets, but also between markets and institutions. Such strong interconnections allow the system to better diversify across small shocks. This also helps improving the ability of the system to exploit the risk bearing capacity of the economy through a wider allocation of risks. However, these developments certainly also induce higher procyclical financial behaviors and higher risk taking than before, increasing exposure to large systemic shocks such as large shift in asset prices or rapid changes in aggregate liquidity.

Consequently, in the aftermath of the crisis, the regulatory system has been reviewed to include a systemic perspective to the financial risk assessment, to enlarge the tools available to contain the risks and to better take account of the procyclicality of financial risks.

As far as monetary policy is concerned, as mentioned above, the pre-crisis conventional wisdom was that central banks should focus on stabilizing the aggregate price level, the control of inflation being therefore the main monetary policy objective (potentially complemented with the control of the economic activity through the output gap stabilization). By focusing on an inflation stability goal, it was argued that central banks are also, to some extent, dealing with financial stability issues, since financial imbalances manifest through inflation. In such a view, financial imbalances were not to be subject of particular concern for monetary policy, except if they affect the inflation path. This "benign neglect" posture of the central bank supposes that it should not be concerned with developments in the financial sector, but rather intervene to support the economy if the risk materializes. This commonly accepted view on the role of monetary policy has been questioned following the 2008/2009 financial crisis both among policy-makers and academics, for several reasons.

First, the crisis has evidenced that inflation stability is not enough to guarantee the stability of the financial sector. Indeed, the recent crisis emerges in a context of unprecedented low and stable inflation at the global level. Second, some arguments point the fact that monetary policy was (at least in large part) responsible for the risk accumulation that culminated later on in a global financial crisis (Giavazzi and Giovannini, 2010; Frankel, 2012). The monetary policy-making can create an environment which encourages risk taking behavior from the part of households as well as financial institutions. Third, the crisis has shown that when it occurs, a financial shock can be very costly for the real economic activity, and its effects can be very persistent, perpetuating a prolonged period of high financial and macroeconomic turmoil. And finally, the traditional monetary policy-making can be limited in its ability to clean-up afterward and mitigate those adverse consequences of a crisis on both the financial sector and the macroeconomic environment. Therefore, in the wake of the crisis, there have been calls for more attention to financial risks in the monetary policy-making.

III. The purpose of the thesis

The work conducted in this dissertation is precisely related to the debate on the extent to which financial instability, in the sense of increase in financial risks,[4] may be of particular concern in a context where monetary policy is mainly focused on an aggregate price stability objective (typically, in an inflation targeting regime). It deals with relevant issues regarding the monetary policy-making articulated toward the main objective of inflation stabilization, and the recently revived concern for financial instability which is required to be better taken into account in the modern central banking. It highlights some concerns in the inflation-stability-based monetary policy-making with respect to financial stability, and assesses some responses strategies to those concerns as well as their effectiveness.

Among the key questions addressed in this thesis, we investigate the extent to which the monetary policy regime has made a difference in mitigating the recent global financial shock. Especially, as mentioned earlier, some arguments have emerged in the wake of the crisis, suggesting that the monetary policy strategy in which the main central bank's objective is inflation stabilization might have favored this global financial turmoil. However, other characteristics of such a policy regime, evidenced in the existing literature, suggest that it may outperform the other monetary policy frameworks when faced with a large shock. We assess precisely those comparative performances of alternative monetary policy regimes during the crisis. Such an investigation of the effect of the inflation targeting monetary policy strategy in crisis periods has not yet been subject to particular attention in the existing literature. We therefore contribute to fill this gap.

We also investigate the relationship between monetary policy, financial stability and macroprudential policy. As stated above, the monetary policy-making has been historically associated with financial stability issues, although to various extent over time. The recent crisis seems to have revealed important evolutions in this relationship, which have not been properly assessed and taken into account in recent decades. Therefore, it seems relevant to shed light on these interconnections between the financial sector and the central banks' policy setting. Furthermore, given the limitations of the prudential framework prevailing before this global financial shock, a growing literature among academics, but also debates among policy-

[4] Defining and measuring financial instability is a tricky issue which is assessed thorough this dissertation. Especially, chapters I and III provide more detailed discussions in this respect.

makers, are now investigating alternative approaches and tools to better assess financial risks and contain them. These new approaches, usually referred to as macroprudential policies, however need to be closely analyzed, given their recent implementation and limited historical experiences. Besides, this framework is likely to strongly interfere with monetary policy, posing the key question of the appropriate institutional setup which should guide the implementation of those two policies, and the need for coordinated actions between the two authorities. All those features stress the relevance to pay a particular attention on the nexus between financial stability, monetary and macroprudential policies; an issue we deal with.

Discussing the crisis prevention role of central banks, especially in the wake of the crisis, it has been argued that monetary policy should lean against financial imbalances to avoid financial bubbles and contain financial risks. However, other arguments suggest that such a monetary policy response can generate trade-offs between the traditional central banks' objectives and this additional financial stability goal. Our work provides some insights on this issue by investigating the existence of such trade-offs. Following the above discussion, we further assess the extent to which including a macroprudential instruments aiming to address the specific financial risk considered (while the central banks remains focused on its standard macroeconomic stability objective), can improve the overall stabilization outcome.

Our analysis in this thesis pays particular attention on emerging markets economies. At least two main reasons have motivated a particular concern for this group of countries. First, an increasing number of those countries has moved or is seeking to move toward a framework characterized by an independent monetary policy, with the main objective of inflation stability. Indeed, among the group countries which have adopted the inflation targeting regime, roughly two-third are emerging markets and developing economies. Given the criticisms against this policy strategy with regard to financial stability in the aftermath of the recent crisis, it seems important to look more closely at the relevance of this issue in emerging countries, and to derive potential lessons and policy implications. Besides, to the best of our knowledge, this concern for financial stability in emerging market inflation targeters has not been investigated in the existing literature.

The second motivation is related to the sources of financial instability in those emerging market economies, and especially their vulnerability to external shocks. With the growing integration into the global financial system, emerging countries are increasingly exposed to external financial shocks which their domestic financial system is not yet ready to fully manage. Furthermore, the adoption of inflation targeting, which requires a freely floating exchange rate regime, is likely to increase this exposure to external risks which manifest through higher volatility of the exchange rate with important consequences in terms of financial and macroeconomic instability. Especially, international (and potentially highly volatile) capital flows to emerging countries raise particular concerns for the stability of their financial sector. The recent crisis has contributed to stress this issue through the consequences of the large surge in international capitals in emerging markets when the crisis erupted, and more recently, through the effects of flows reversal following the U.S. monetary policy normalization. We therefore aim at bringing some insights on this issue by assessing a particular policy response to those risks, namely foreign exchange interventions.

For the purpose of assessing all the above mentioned concerns, we relies on statistical, empirical (estimations) and theoretical methods. Statistical approaches include preliminary simple graphical investigations; the Principal Component Analysis (PCA), a data aggregation method on which we rely for the purpose of constructing a composite financial instability index; and a cluster analysis method (based on Dendrograms) which allows assessing heterogeneities and dissimilarities among inflation targeting countries before and after the adoption of this monetary policy regime. Estimation strategies include, events studies and impact evaluation technics such as the Difference in Differences method and the Propensity Scores Matching approach (PSM), which allows addressing the potential self-selection bias surrounding the adoption of inflation targeting, when estimating its effect on some relevant economic of financial variables. We also use the two stage Generalized Method of Moments (GMM), as a strategy to overcome potential endogeneity bias in our empirical investigations. Finally, we rely on limited dependent variables approaches, including random effects Probit and Logit models as another estimations technic. Regarding the theoretical tools, our starting point is the reduced form new Keynesian model, which is complemented by including equations capturing a banking sector and an asset price bubble. This extended theoretical framework allows assessing the interaction between monetary policy and macroprudential policy and their effects on the financial and the macroeconomic environment, when financial shocks occur.

The main questions investigated, the structure, and the main conclusions of each chapter are described in more details below.

IV. Structure of the thesis

The first chapter attempts to provide a broad and comprehensive discussion on the relationship between monetary policy, the macroprudential framework, and financial stability. It starts by reviewing the conventional wisdom which guided the conduct of monetary policy for decades before the recent global financial shock. It is argued that during this period, the monetary policy-making was mainly oriented toward stabilizing the aggregate price level, without particular concern for financial stability. The global financial crisis has challenged such a strategy. Therefore, the chapter next assesses the extent to which monetary policy can promote financial instability, or rather contribute to dampen financial risks. Accommodative monetary policy conditions can be associated with higher financial instability through the risk taking channel, search for yields, increase in leverage from financial firms, increase in borrowing from the part of households, or increase in asset prices which can generate financial bubbles. On the contrary, there have been recent calls for central banks to respond to financial imbalances when setting their policy interest rate. This leaning against the wind strategy may however generate trade-offs between the policy objectives. We therefore introduce a discussion on macroprudential policy, as a better framework to address financial risks.

Macroprudential policy aims at dealing with the system-wide risk, and relies on a large set of tools which can be targeted to various sources of risk. We also stress that an effective macroprudential framework requires a good assessment of financial risks. Another important issue for macroprudential policy is the institutional arrangement. In this respect, the chapter first examines the pros and cons of the "rule" versus "discretion" approaches in designing a macroprudential setup. It then discusses the governance issues (through the "central bank model" in which the central bank is in charge of both monetary policy and the implementation of prudential policy; and the "separate institution model" where the two policies are under distinct institutions' responsibility) which can guide the prudential framework. In any case, we argue that strong coordination between monetary policy and macroprudential policy is required.

This first chapter has introduced a discussion criticizing the monetary policy regimes whose primary goal is inflation stability. Following this discussion, **the second chapter** investigates how countries which have adopted the inflation targeting regime performed during the global financial crisis, compared to the others. The chapter starts by providing a broad presentation of the inflation targeting framework, including a definition of this policy strategy, some theoretical aspects of the framework and some features related to its implementation. In proceeding with the comparative analysis between targeting and non-targeting countries during the recent crisis, our argumentation is based on the existing literature which suggests that targeting countries are expected to perform better in coping with such a crisis thanks to better initial macroeconomic conditions (including better fiscal and external positions, lower debt and lower exchange rate volatility), but also thanks to higher central bank credibility and higher initial policy rates which provides more room for monetary policy accommodation when needed.

Our empirical framework is based on a rigorous approach relying on the difference in difference technic, in the spirit of Ball and Sheridan (2005). The sample consists of 67 developed and developing countries, including 20 inflation targeters. The main findings suggest that targeting central banks have significantly performed better in mitigating the rise in inflation volatility during the crisis, in accommodating the shock by lowering the policy rate, and in avoiding a sharp increase in real interest rates during the crisis. However, in spite of those relatively good achievements regarding the monetary policy-making and the better initial macroeconomic conditions in targeting countries, considering the economic performances at large (in terms GDP growth), inflation targeting did not make any difference in addressing the 2008/2009 financial shock.

It is argued that the latter somewhat disappointing finding regarding the performances of inflation targeters during the crisis can be explained by higher initial fragility of their financial sector in the pre-crisis period, an issue we investigate more precisely in **the third chapter**. This third chapter deals two main questions. First, does the adoption and implementation of inflation targeting associated with higher financial instability?[5] If so, is this higher financial fragility due to the fact that those inflation targeting central banks are less concerned with

[5] As discussed in the first and second chapters, such monetary policy frameworks have been particularly criticized in the aftermath of the 2008/2009 crisis.

financial imbalances when setting their policy interest rate? These issues are investigated through an empirical analysis based on sample of 26 emerging markets economies, including 13 targeting countries, using quarterly data over the period 2000 to 2010. The chapter starts by investigating statistically and comparatively, the financial conditions in some regional groups (Asia, Europe, Latin America, and Middle East and Africa), based on selected financial indicators. Next, we discuss some issues in assessing and measuring financial instability, and we argue that relying on single indicator such as a credit aggregates may be misleading as it only provides partial information regarding the actual financial conditions. In this respect, we construct an aggregate financial conditions index relying on large set of financial indicators capturing internal as well as external vulnerabilities. Based on GMM and a variety of PSM estimates, we evidence that on average inflation targeting countries are more financially vulnerable than their non-targeting counterparts.

The last part of the chapter investigates the extent to which this higher financial instability in inflation targeting countries is due to the fact that targeting central banks are less concerned with financial imbalances when setting their policy interest rate. For this purpose, augmented Taylor-type rules, including a financial indicator, are estimated, both for the group of targeting versus non-targeting countries (using panel data), and on a country-by-country basis for inflation targeters. The estimation of these reaction functions takes account of possible asymmetries in the central banks' responses, and makes some assumptions regarding the timing of these responses. Considering various indicators of financial instability, including our composite index, the results suggest that targeting central banks are more responsive to financial imbalances in their monetary policy-making, compared to non-targeters.

Our conclusion in the third chapter, that despites central banks' responses to financial instability, targeting countries are more financially unstable, to some extent, questions the effectiveness of the leaning against the wind strategy in mitigating financial risks. This issue is investigated more closely in **the fourth chapter**. This chapter proceeds in two main steps. First, it explores the existence of trade-offs between macroeconomic and financial stability, when the monetary authority implements a leaning against the wind strategy. To shed light on this issue, we rely on theoretical framework based on the standard reduced form three-equation new Keynesian model that we supplement with a fourth equation describing an asset price bubble. The bubble process, which captures the risk accumulation in the financial sector, is endogenized by assuming that the policy interest rate has an influence on its bursting probability. Furthermore, the financial bubble is assumed to have an impact on the aggregate demand. We explore the changes in inflation, output gap and bubble volatilities for various types of shocks and alternative responses from the monetary authority. Those first simulations reveal that, when the central bank reacts directly to financial imbalances, a trade-off indeed emerges between its primary objective of macroeconomic stability and financial stability.

The findings in this first analysis seem to emphasize the limits of the leaning against the wind strategy, and to some extent, support the argument that other (macroprudential) instruments may be more appropriated to deal with financial imbalances. Second, the chapter therefore investigates the extent to which including a prudential instrument in the policy framework can improve the stabilization outcomes. To this end, the model described above is extended by including a banking sector. It is assumed that credit supply feeds the bubble and increases financial risks. Consequently, the prudential instrument is set in the form of bank capital constraint (fixed or countercyclical capital requirements) aiming to contain the increase in bank loans. The findings with this new theoretical framework can be summarized as follows: first, the implementation of the prudential instrument provides better financial stability outcomes than the previous framework. Second, countercyclical capital requirements performs better (than fixed capital requirements) in stabilizing the financial sector. Third, a two-pillar strategy which includes both a prudential policy and the leaning against the wind, provides better macroeconomic and financial stabilization outcomes, when faced with financial shocks.

Focusing on emerging market economies, and given their higher vulnerability to external shocks, exchange rate fluctuations and their potential impact for the financial sector stability is a matter of particular concern. In this respect, **the fifth chapter** investigates the extent to which the control of exchange rate might be used as prudential tool among emerging countries, to address their financial vulnerability to external risks. To emphasize the relevance of this issue, we evidence that although a commitment to total flexibility of the exchange rate regime implies no or very limited attempts to control the exchange rate, when the financial conditions deteriorate (suggesting higher financial fragility), foreign exchange interventions are used as a tool to mitigate the exposure to external risks. To this end, we start by identifying those emerging countries which (at least officially or in theory) are supposed to operate in a freely floating exchange rate regime. In this respect, countries which have adopted the inflation targeting monetary policy strategy offer an interesting baseline for our study.[6]

Next, we assess the extent to which those countries may deviate from this initial commitment and attempt to control the exchange rate. The empirical tests are based on a sample of 36 emerging markets economies, including 16 inflation targeters, using data over the period 1985 to 2010. We rely on panel data econometric estimates using limited dependent variable models (ordered Logit and Probit), and an impact evaluation technic (matching on propensity scores). We evidence that countries with poor financial and macroeconomic conditions, countries which are more vulnerable to external shocks, are more likely to rely on foreign exchange interventions as a prudential strategy or as means to improve their policy outcome. Especially, higher banking sector exposure to external risks and higher levels of external debt are associated with higher probability of foreign exchange interventions.

[6] First, the exchange rate regime is on average more flexible in those targeting countries, compared to other emerging markets. Second and more importantly, by adopting the inflation targeting strategy, those central banks officially commit to a freely floating exchange rate regime (for a credible and effective inflation targeting framework).

Chapter I

Financial Stability, Monetary and Macroprudential Policies: Exploring the Nexus

"*The crisis has fostered the recognition that systemic risk can grow under the surface of apparent economic tranquility. Financial stability need not therefore emerge as a natural by-product of an appropriate macroeconomic policy mix. Rather, achieving the objective of financial stability requires dedicated macroprudential policy*". (IMF, 2013a)

I. Introduction

The late 2000s financial crisis has revived the debate on the relationship between monetary policy and financial stability. The crisis has also stimulated research on the role and the relevance of macroprudential policies, designed with the purpose of addressing financial risks. The prevailing conventional wisdom on the role of monetary policy focused on inflation stabilization without particular concern with developments in the financial sector is a matter of controversy, since the recent crisis. This chapter discusses and reviews some relevant issues related to these debates.

The traditional and commonly accepted role of the monetary policy-making which should be guided by an aggregate price stability objective has prevailed among most central banks in the last couple of decades. In such a framework, the issue of financial instability is not of particular relevance as long as financial developments do not affect the perceived or expected inflation. Besides, it is recognized that by ensuring the control of inflation, monetary policy is also dealing with potential financial risks. However, the recent global financial crisis has led to question this standard view. It is now recognized that both aggregate price and output stabilization do not guarantee the overall macroeconomic, and particularly the financial sector soundness. The interactions between monetary policy and the financial sector need to be reconsidered and more accurately scrutinized. The monetary policy stance can contribute to increase financial instability even when the inflation rate seems to be on the expected path. Particularly, the U.S. Federal Reserve has been criticized because the loose monetary policy (characterized by low interest rates) conducted in the early 2000s has been a factor which contributed to increase risk taking behaviors that subsequently culminated in a global financial crisis.

Recent discussions among scholars and policy-makers have stressed the strong interconnection between monetary policy and the financial environment. Given that developments in the financial sector are not independent from the monetary policy setting, central banks are now asked to be more attentive to financial imbalances than before. The "leaning against the wind" approach in the policy-making, where central banks take actions to dampen increasing financial risks in addition to their traditional macroeconomic stability objective, is also advocated. However, such a strategy, it has been argued, can be limited in several aspects. A trade-off can emerge between the standard inflation stabilization objective of the central bank and the additional financial stability objective. The short term interest rate, which is the main monetary policy instrument, can be found to be ineffective in dealing with specific financial risks.

Macroprudential policies have gained growing interest in the aftermath of the global financial crisis. These policies provide a broader framework to deal with financial imbalances. Contrary to monetary policy, they rely on a large set of instruments which can be targeted to specific sources of financial risks. Besides, contrary to microprudential policies, they are designed to address system-wide financial risks. In this respect, they account for interconnections between financial institutions, but also the relation between the financial sector and the real economy. Although the use of prudential instruments is now widespread, experiences are relatively recent, and the analysis of their effectiveness is therefore rather limited. Historical and sufficiently long data series might be needed to empirically assess the extent to which those prudential tools succeed in dealing with risks they are supposed to cope with.

Some important issues remain at the forefront of the policy-making aiming to maintain financial stability. First, for prudential policies to be effective, financial risks have to be accurately scrutinized and identified. This will determine the decision to act, the timing of the required action, but also the adequate instrument to be used. Financial instability (or financial risk) remains difficult to define and further researches are still needed in this regard, despites recent improvements in the literature. Another issue in dealing with financial risks is the adequate institutional framework which should govern the macroprudential policy, and especially how it should interact with monetary policy. In a context of growing financial globalization, the recent crisis experience has also stressed the need for an international coordination of macroprudential policies, in order to take account of the related potential spillovers. A further issue stressed in much more recent analyses is related to the growing importance of the non-traditional banking sector activities, potentially suggesting a risk shifting toward a less regulated segment of the financial system. In this respect, a particular attention seems to be required with regard to the shadow banking.

The remainder of the chapter is structured as follows. Section II discusses the prevailing consensus on the monetary policy-making before the crisis. Section III proceeds with an analysis of the relation between monetary policy and financial stability, discussing to which extent the monetary policy setting can affect the financial risk. Section IV describes the macroprudential framework. Starting with a definition of the macroprudential policy, it also discusses some issues regarding the assessment of financial risks, provides a list of prudential tools and their potential role, and reviews some existing experiences on the effectiveness of macroprudential policies. Section V deals with institutional issues related the macroprudential setup. Finally, section VI concludes.

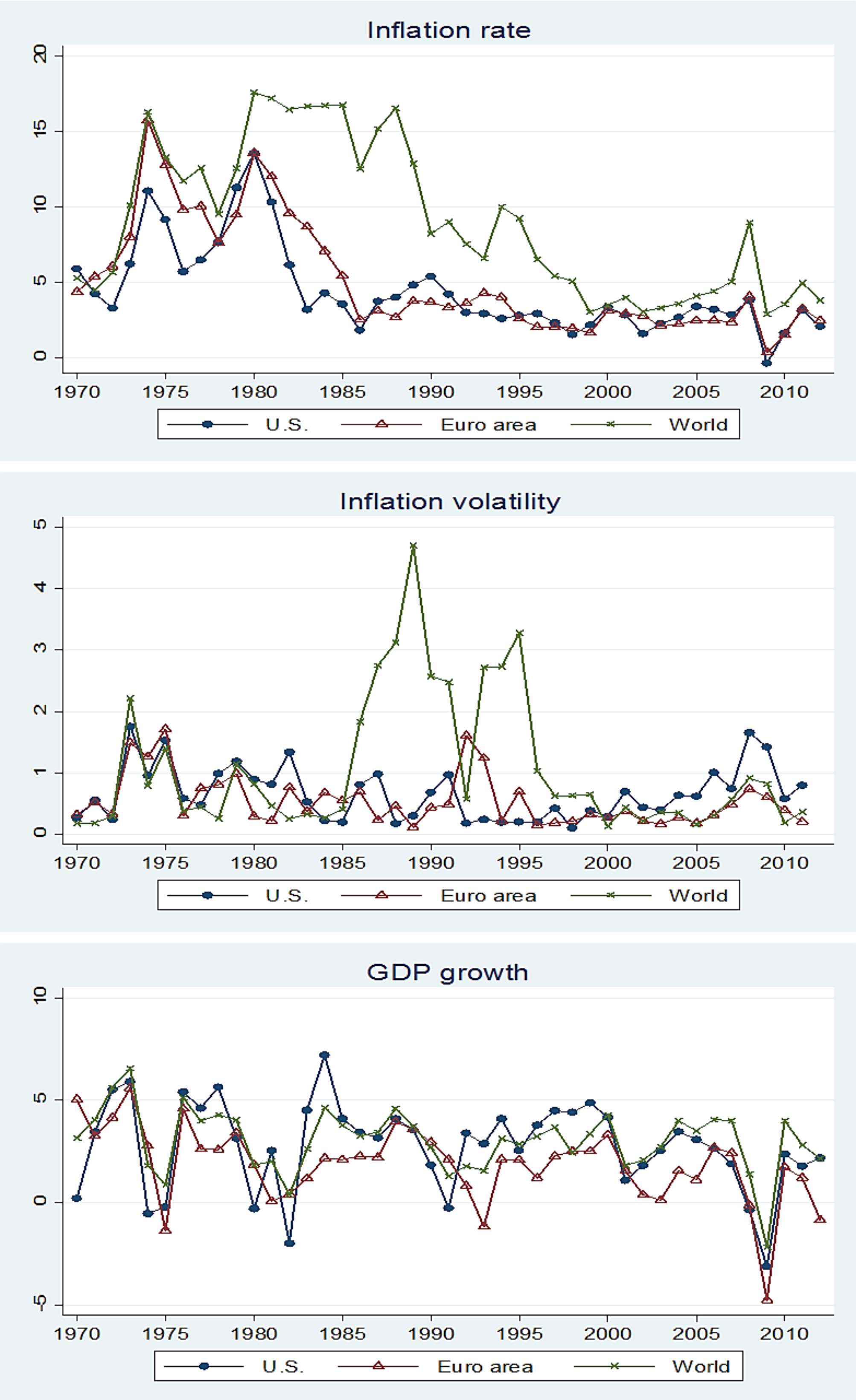
II. The prevailing view on monetary policy before the crisis

According to the conventional wisdom, monetary policy is devoted to promote and ensure the stability of the macroeconomic environment, and especially the aggregate price stability. To some extent, historical experiences in the central banking and the evolution or changes in inflation among advanced economies may explain this commonly accepted view regarding the role of monetary policy. For the U.S. and the European economies, but also for other most industrialized countries (including the U.K. and Japan for example), the early 1970s to mid-1980s period was characterized by high levels of changes in aggregate price and high inflation volatility, while financial stability was not a matter of particular concerns. This period also revealed a relatively higher instability of the economic activity, compared to subsequent decades.

As a result of disinflationary policies implemented to cope with this instability of the macroeconomic environment, inflation fell considerably by the late 1980s and has remained on average lower than 3% since then, in most high income countries. In the wake of the stabilization of aggregate price levels, the GDP growth also showed lower volatility, suggesting more general improvements in stabilizing the overall economic environment (figure I.1[7]). These favorable achievements in terms of economic stability have been mainly attributed to the implementation of sound and adequate monetary policies (Blanchard, 2014 argues that it is likely that central banks can take the credit for it), even though other factors could have played a significant role (more general macroeconomic conditions related to favorable economic shocks, the force of globalization which increased competition but also enhanced structural changes in some sectors such as labor market, more flexibility in the production activities, etc.).

[7] The Euro area consists of the 17 member countries, as established in 2007.

<u>Figure I.1</u>: Long term evolution of inflation rate, inflation volatility and GDP growth



Annual inflation volatility is calculted as standard deviations of monthly inflation rates. Data from International Financial Statistics and World Development Indicators.

Lessons from this 1970-80s' experience certainly bear the foundations of the prevailing view on the monetary policy-making, at least until the late 2000s financial crisis unfolded. An immediate lesson that can be derived from this experience refers to the fact that monetary policy is effective in controlling the long-run path of the aggregate price level. This is of relevance because high and unstable inflation rates can impair the economic activity, particularly in the long-run. The role of the monetary authorities in controlling inflation appears to be crucial in ensuring sound economic conditions and in contributing to sustainable economic growth. However, strong achievements or performances in stabilizing inflation requires good private sector's expectations anchorage, as private agents today's economic decisions are based on their perception and expectations regarding the future path of inflation. In this respect, the central bank's commitment on its price stabilization objective and especially, the confidence that economic agents might have on that commitment play an important role in determining the success of the monetary authority in meeting its target. In other words, the central bank's credibility is a key determinant of its performance in maintaining price stability. In this respect, the increase in central banks' independence since the 1980s, in both advanced and emerging countries has certainly played an important role regarding their achievements.

The ability of central banks to affect the aggregate price has led to the consensus that the primary objective for monetary policy should be to guarantee inflation stability. In order to strengthen its effectiveness in achieving this goal, policy makers have discussed and looked for a framework which can reinforce the central bank's commitment and credibility. This framework specifies explicitly the monetary policy's objective (sometimes with a numerical inflation target), highlights the responsibility and the accountability of the central bank to reach the target, and stresses the meaningful role of monetary policy transparency. One of such a framework which has emerged in the early 1990s, referred to as the inflation targeting, has gained interest among many industrialized economies, but also in an increasing number of emerging markets' central banks. The purpose is to better anchor private sector's expectations through the enhancement of central bank's credibility which ultimately leads to a better outcome in terms of inflation stabilization.[8]

[8] The inflation targeting monetary policy strategy is described in more details in the next chapter.

Broadly describing the role of monetary policy before the 2008/2009 crisis, Borio (2011) enumerates four propositions summarizing the prevailing view of the central banking. The first is that "*price stability is sufficient for macroeconomic stability*", highlighting the main contribution of monetary policy to macroeconomic stability. The second proposition stated that "*there is neat separation between monetary and financial stability functions*". While the central bank should remain focused on the aggregate price stabilization objective, the supervisory and regulatory institution should be concerned with financial stability. Third, "*a short term interest rate is sufficient to capture the impact of monetary policy on the economy*". The short term interest rate is the monetary policy main instrument used to affect the real economy and to control the level and the variability of inflation. And forth, "*if each central bank looks after its own economy, the global monetary stance will also be appropriate*". This last statement highlights the lack of monetary policies coordination at a global level.

One of the main points to be stressed here is that, in the pre-crisis period, the monetary policy-making was not (at least sufficiently) concerned with financial stability issues. Mishkin (2011) supports this view by highlighting the fact that even while central banks were aware that financial imbalances might be detrimental for the economic activity, general models used for forecasting and policy analysis in the central banking did not account for the impact of financial frictions and disruptions as a source of economic cycle fluctuations. It was commonly admitted that financial disequilibrium might not be a particular source of concern for the central bank as long as inflation remains under control. Under an inflation stability objective, monetary policy predictability can enhance financial stability by easing the evaluation of the future impact of some financial decisions. Besides, an aggregate price stability objective which aims at avoiding inflationary as well as deflationary pressures, can promote financial stability since it reduces risk associated with financial contracts negotiated in real terms, and prevents the risk of high increase in the real debt outstanding. In short, with their inflation stability objectives, the monetary authorities are also (at least indirectly) dealing with financial stability concerns.

III. Monetary policy and financial stability

According to the conventional view discussed above, inflation-stability-based monetary policy framework is also perceived as contributing to strengthen the financial sector stability. However, this doctrine has faced vehement criticisms in the aftermath of the 2008/2009 global financial crisis. In particular, given the relatively low and stable inflation prevailing in the pre-crisis period, accommodative monetary policies conducted in the early 2000s (especially in the U.S.) have been pointed as a main source of growing financial risks which generated the crisis. It comes out that the impact of monetary policy on the financial sector is not straightforward. This section discusses to which extent monetary policy can contribute to increase financial risks, or rather improve the financial sector stability.

Before we turn to this discussion, let us start by stressing some issues underlying the fact that central banks may be concerned with developments in the financial sector, above and beyond a financial stability objective. First, monetary authorities can scrutinize and even respond to changes in some financial variables because such a strategy is likely to improve their achievements regarding the primary inflation stability objective. In such a framework, these financial variables are perceived as providing some information regarding the future path of inflation. They can be regarded as forward-looking predictors of changes in inflation, and therefore may guide central banks in fine-tuning their policy-making and ultimately improve their inflation stabilization performances. The central bank may raise its policy interest rate in response to an increase in credit aggregates for example, not necessarily because of financial stability concerns, but rather because such an increase in domestic credit may subsequently generate increase in aggregate price.[9]

A second rationale for a central bank to be concerned ex-ante with changes in the financial environment might be related to the risk that ex-post, if the crisis materializes, the main monetary policy instrument might prove to be ineffective to restore the economic stability or mitigate the effects of the shock. The recent financial crisis clearly provides some insights in this respect. Central banks in many advanced economies (including the FED, the BoE and the ECB) have been constrained in their attempt to cope with the crisis by the zero lower bound of nominal interest rates. Moreover, while the monetary authorities may have some room for

[9] We empirically discuss and investigate this issue in Chapter III when estimating central banks' reaction functions.

maneuver to cut the policy interest rate, in crisis period, it is likely that transmission mechanisms might be impaired. The banking sector might be reluctant to lend, for example because of recent experience of non-performing loans. Unconventional monetary policies (such as liquidity provisions, private and government asset purchases, and forward guidance) have been implemented to overcome the zero lower constraint in the aftermath of the late 2000s global financial crisis.

Another issue which can be discussed in standard macroeconomic models is related to the extent to which financial risks mainly translate into aggregate demand shocks or into supply shocks. In the former case, it may be argued that the central bank should merely strengthen its response to changes in the aggregate demand in order to restore the overall economic and financial stability, without necessarily responding directly to financial imbalances. Indeed, in such a scenario, a trade-off is not to be expected in the monetary policy-making. On the contrary, if the financial risks translate into supply shocks, strengthening the policy responses to those supply shocks may generate a trade-off between the traditional monetary policy objectives, namely inflation and output stability. In this later case, the central bank may be required to be especially and more directly concerned with financial stability.[10]

III.1. Can monetary policy increase financial risks?

Although aggregate price stability may create an economic environment favorable to financial stability, there are arguments suggesting that monetary policy can also generate conditions encouraging risk taking behavior from the part of economic agents, therefore increasing financial instability.

A first effect of monetary policy on financial risks can work through the short term interest rate setting. Two main mechanisms can be mentioned, referred to as "risk taking channel"[11]

[10] However, as we evidence in Chapter IV, this very simplistic analysis of the monetary policy response to financial instability is not straightforward and may bear some limitations. First, we argue that increases in asset prices bubble are more likely to affect directly the aggregate demand (although the aggregate supply is also affected). Nevertheless, responding to those changes in the aggregate demand does not prove to be effective neither in stabilizing the main macroeconomic variables, nor in avoiding trade-offs. Moreover, we show that the best stabilization performances (in terms of both financial and macroeconomic stability) are achieved when the central bank responds to financial imbalances in addition to the implementation of a prudential policy.

[11] To our knowledge, the risk taking channel is first discussed in the literature in 2008 by Borio and Zhu, now referred to as Borio and Zhu (2012).

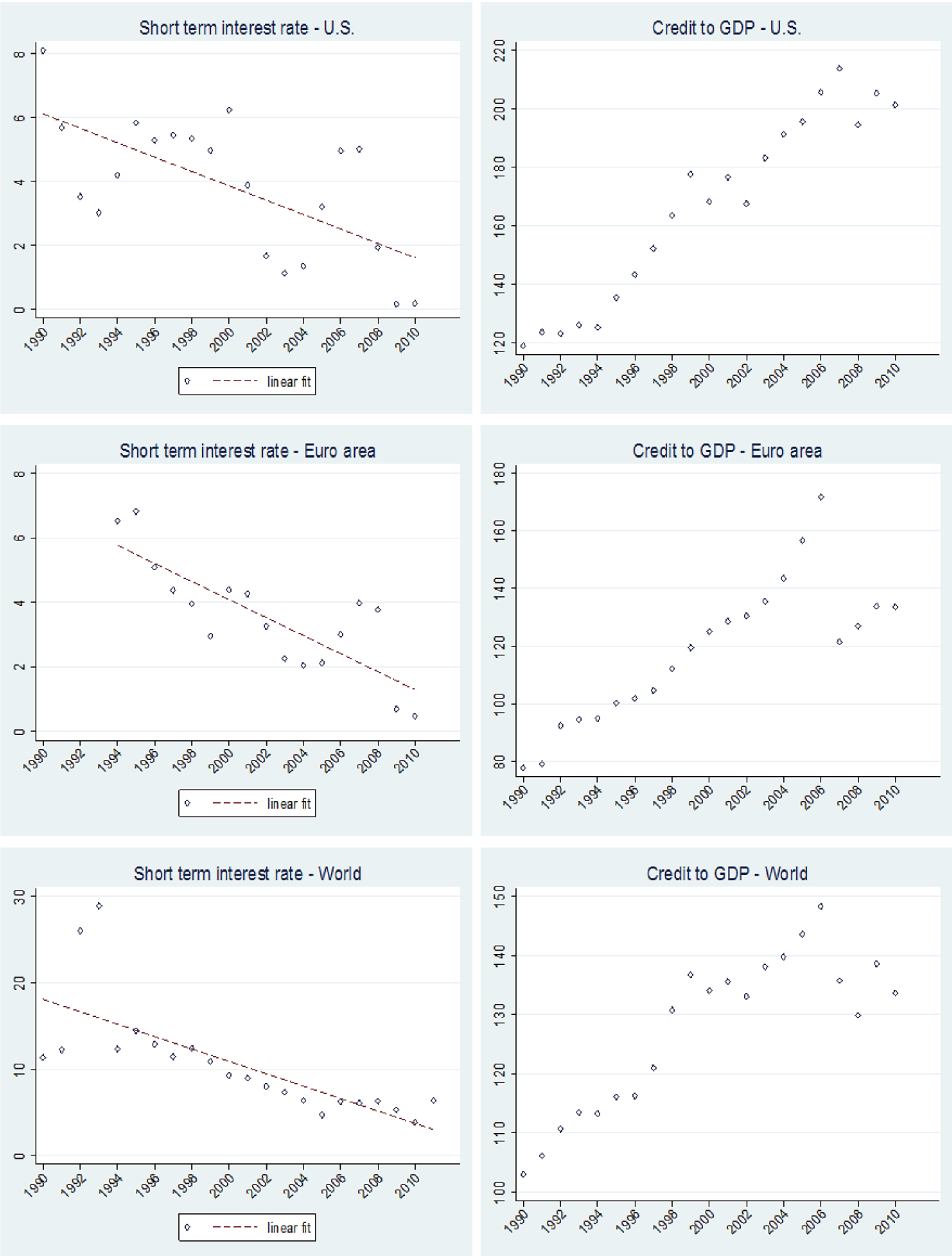
and discussed in the existing literature (Rajan, 2005; Adrian and Shin, 2010, Hahm et al., 2012; Borio and Zhu, 2012, among others).

Low interest rates increases incentives to search for yields from the part of financial investors. Consequently, they would be inclined to switch toward assets with higher yields, but which may also be associated with higher risks. In addition, newly acquired assets may be foreign assets which may increase the vulnerability of these financial institutions (or the domestic financial system as a whole) to adverse external financial shocks. This exposure to international shocks is particularly relevant in emerging countries where the risk of currency mismatch may prevail to a larger extent. In financial institutions such as insurance companies, these incentives to search for yields may be further motivated by fixed rate contracts and the resulting obligation for companies to meet their commitments. As regards asset managers, the incentives can come from contractual arrangements allowing compensations based upon returns on assets.

Low interest rates also increase net interest margins with positive effect on the financial firms' value. As a result, this raises the ability to further increase their leverage and thereby their risk exposure. Moreover, low interest rates can increase the real value of the collateral and ease the lending conditions. A straightforward consequence is an increase in credit in the economy. In these cases, the consequences of low interest rates work through income and valuation effects.

Apart from these effects of the policy interest rate setting on risk taking from financial institutions, there are also important implications for households. Low interest rates may favor increasing indebtedness since the borrowing conditions improve: the cost of funding decreases and the value of collateral (real assets) goes up, further increasing borrowing to invest in real assets (figure I.2 shows that on average during the last two decades, the decreasing short term interest rates have been associated with significant increases in credit to private sector). Such circumstances brought together ingredients for a bubble on the real assets market, with consequences in terms of deterioration in the sustainability of households' indebtedness. In the event of a negative shock, the bubble bursts, generating a crisis with potential important effects on the overall financial system, but also at the macroeconomic level. The recent subprime crisis in the U.S. financial market is a good example illustrating this phenomenon.

Figure I.2: Short term interest rate and credit to private sector



Data from International Financial Statistics and World Development Indicators & Global Developmemt Finance

Improvements in the monetary policy-making since the early 1990s and better central banks performances in stabilizing the real economy may also encourage risk taking. Indeed, central bank credibility and good expectations' anchorage reduce uncertainties and may lead economic agents to under-estimate the perceived level of risk. This opposition between improvements in the monetary policy-making and the potential for increasing risk taking behaviors is referred to as the "paradox of credibility" (Borio et al., 2003). Besides, the "cleaning up" approach[12] of monetary policy which prevailed in many central banks, and where financial institutions anticipate that the monetary authority will substantially cut the policy interest rate in the event of crisis, in addition to other measures aiming at limiting the losses (and the related potential negative effects on the financial sector and the real economy), might also encourage risk taking during calm periods. In such a context, because of moral hazard, financial institutions underestimate their losses in case of negative shocks since the central bank is expected to mitigate the damaging consequences whenever the risk materializes (see for example Farhi and Tirole, 2012). The risk might therefore be higher, particularly if the central bank is conducting an expansionary monetary policy.

De Nicolo et al. (2010) discuss 3 channels through which monetary policy easing can increase risk in the banking sector. The first is the assets substitution channel, which, in line with the above discussion describes the fact that low interest rates reduce banks' yields on safe assets and encourage switching toward a portfolio with higher yields but riskier assets. The second is the "search for yields" channel, describing some financial institutions' constraints regarding their commitments towards creditors. And the third is the leverage channel (developed by Adrian and Shin, 2009), suggesting that monetary policy easing will increase bank equity and reduce their leverage. Banks will therefore increase their assets purchase, contributing to further increase assets prices, favoring an asset price bubble. In addition to these traditional channels through which monetary policy can increase financial risk, they also describe a mechanism where the low interest rates can decrease the banks' risk taking. A decrease in short term interest rate will lower the banks' deposit rate which will only partly translate to lending rates. The intermediation spreads increase, boosting the banks' profits and lowering the risk taking.

[12] The "cleaning" approach (as opposed to the "leaning", discussed in the next section) in the monetary policy setting suggests that central banks should not respond preventively to financial imbalances, but rather just clean up when a financial crisis materialized.

De Nicolo et al. (2010) further highlight the fact that the net effect of monetary policy on the financial system (the banking sector) will depend on two alternative forces, underlying the health of the banking system: the "portfolio effect" and the "risk shifting effect".[13] The latter may prevail especially in a weaker banking system (since it is mostly driven by limited liability), while the former is more likely to prevail when bank capitalization is high, since banks will behave like institutions without limited liability protection. It is therefore predicted that, in calm periods and good bank capitalization, monetary policy easing will be associated with high risk taking, while the opposite effect may be expected when the banking sector is under stress.

Overall, the above discussion suggests that central banks can favor increasing financial risks, especially during tranquil periods and with a loose monetary policy stance. In this respect, another commonly accepted view is that monetary policy should be more cautious about financial imbalances and can play a major role in preventing risk taking and avoiding financial crises.

III.2. Can monetary policy prevent financial instability?

The 2008/2009 crisis has reignited the debate on the role that monetary policy should play to safeguard or improve the financial sector stability. One of the main relevant lessons learned from the crisis is undoubtedly the fact that inflation stability is not enough to guarantee a stable and sound financial system. The early 2000s was characterized by low and stable inflation as well as stable economic growth performances: the so-called "great moderation" (figure I.1). But this does not preserve the global economy from growing financial risks and the house price bubble which crashed in 2007. The U.S. Federal Reserve has been criticized because of the loose monetary policy implemented during the pre-crisis period. Such a policy has certainly contributed to encourage risk taking behavior from the part of financial institutions as well as households.

[13] The "portfolio effect" describes the fact that financial institutions switch toward higher yield but riskier assets.The "risk shifting" characterizes a banking sector operating under limited liabilities where the risk can be switched from financial institutions to depositors. Banks undertake risky investments (with high yields in the case of positive outcome an important losses in the case of failure) because they do not internalize the losses incurred by their creditors.

A direct implication of the latter statement is that, by simply avoiding a "risk-friendly" monetary policy-making (meaning, by avoiding a conduct of monetary policy which favors the development of financial risks), central banks can significantly contribute to the stability of the financial system. This view is supported for instance by Taylor (2012) who argues that the main source of the early 2000s housing price bubble in the U.S. is the FED deviations' from the required monetary policy stance, given the macroeconomic environment.[14] Especially, it is argued that the policy interest rate was lower than the level predicted by the prevailing conditions in terms of inflation and output gap, according to the rule-based policy followed by the FED until then. Taylor claims that "more rules-based federal funds rate would have prevented much of the boom and bust". According to this view, by committing to a rule (which determines the changes in the policy interest rate depending on the prevailing macroeconomic environment) for the monetary policy-making, and by avoiding deviations from this rule, central banks can significantly contribute to strengthen the stability of the financial sector. A clear, rigorous and predictable monetary policy-making may be sufficient to avoid increase in financial risks, therefore excluding or reducing the need for monetary authorities to respond directly to financial imbalances in addition to their standard objectives.

However, in the wake of the global financial crisis, it has been claimed among both scholars and policy-makers that greater attention should be paid to developments in the financial sector, even when the real economy seems to be on the right track.

As stated by Mishkin (2011), even before the crisis, optimal monetary policy was required to respond to asset prices, because they are relevant elements in the monetary policy transmission mechanism and influence the outcome in terms of inflation and output. While admitting that monetary policy should be more concerned about financial stability, the question of how central banks should react to financial risks/imbalances is much less clear-cut. Some empirical analyses investigating the extent to which central banks are concerned with financial risk estimate central banks' reaction functions (following Taylor, 1993), including a financial indicator (in addition to inflation and output gaps). Such an empirical investigation relies on the assumption that raising the policy interest rate may be an effective

[14] Taylor (2012) argues that, compared to the late 1980s to 2003 period where the FED monetary policy-making was characterized by a rule based approach, since 2003 the policy has been rather more discretionary. This discretionary monetary policy-making which has led to lower policy interest rate, has contributed to increase financial instability in the U.S., by favoring the housing price bubble.

strategy to dampen or contain financial imbalances and growing financial risks. Proponents of this “leaning against the wind” role of the central bank argue that tightening monetary policy will prevent potential bubbles, reduce the bubble’s growth, or even mitigate the impact of a financial crisis on the real economy if the bubble bursts (see Cecchetti et al., 2000; Borio and Lowe, 2002; Borio et al. 2003; Bean, 2003, among others).[15]

A tightening monetary policy stance in response to changes in financial variables implies that central banks rely on the monetary policy instrument, the short term interest rate, to achieve not only their primary objective of inflation and output stabilization but also to deal with financial stability concerns. In such a framework, the central bank’s reaction function can take the following form:

$$i_t = \delta_0 + \delta_1 i_{t-1} + \delta_2(\pi_t - \pi_t^*) + \delta_3 y_t + \delta_4 fc_t + \varepsilon_t$$

Where i is the short term interest rate, π and π^* the inflation rate and inflation target respectively, y the output gap and fc an indicators capturing the financial conditions. Empirical researches which estimate this form of augmented Taylor-type rules include Borio and Lowe (2004), Bohl et al. (2004), Muñoz and Schmidt-Hebbel (2008), Castro (2011), Milas and Naraidoo (2012), among others. Other empirical investigations of central banks’ responses to financial risks rely on VAR models to account for simultaneity in the relationship between monetary and financial variables (Rigobon and Sack, 2003 for the United States, Furlanetto, 2011 for a larger sample of countries). These studies reach different conclusions regarding the central banks’ reaction to financial instability, in both advanced and emerging countries.

Beyond this strand of the empirical literature, other researches rather base their investigations on theoretical models to assess the extent to which central banks should take financial instability issues into account in their monetary policy-making. Disyatat (2010) theoretically investigates the perspective of optimal monetary policy response to financial imbalances. He concludes that to accurately evaluate the monetary authorities’ actions in dealing with financial risks, financial instability should be stated as a clear objective and included explicitly in the central bank’s loss function. This is at variance with other researches arguing

[15] Chapters III and IV provide some empirical and theoretical evidences on this strategy.

that financial variables should merely enter the central bank's reaction function as a new parameter (Bean, 2003). Based on a DSGE model, Castelnuovo and Nisticò (2010) investigate the interaction between monetary policy and stock market in the U.S. Their results from Bayesian estimates of the FED's reaction function over the post-world war II period (1954 – 2007) suggest that it has responded counteractively to stock price fluctuations; a finding which contrasts with other analyzes underlying the FED's unconcern with financial risks in the pre-2007 crisis period.

Gambacorta and Signoretti (2013) analyze the extent to which an augmented Taylor rule, with financial variables (asset price or domestic credit), can improve the monetary policy outcome in terms of macroeconomic stabilization. Using a DSGE model, their simulations' results suggest that in the case of supply-side shocks, a "leaning against the wind" strategy in which the central bank responds to asset prices is a desirable policy because it is more effective than other strategies (strict inflation targeting or central bank stabilizing the output in addition to inflation) in improving the trade-off between output and inflation stability. Following an adverse inflation shock, the fall in output is less important in the augmented central bank's reaction function case, compared to other frameworks. This is due, the authors argue, to the fact that under the standard rule, both short term and lending interest rates rise, depressing investment. On the contrary, under the augmented rule including asset price, the monetary policy stance will be eased on impact, contributing to limit the decline in investment.[16] Analyzing the best monetary policy strategy when the central bank has a financial stability objective, Agur and Demertzis (2013) find that its reaction should be more aggressive but brief. Especially, in the case of a negative output shock (during periods of financial crisis for example), the central bank should cut the short term interest rate deeper than otherwise, but the cut should be short-lived in order to avoid the rise in the risk taking that it could favor subsequently.

The argumentation exposed above advocate that monetary policy can be effective in dealing with financial instability through tightening policies when necessary. Raising the short term interest rate can dampen increasing financial risks and the harmful effects of financial crises on the real economy. However, there are also a number of arguments suggesting that such a policy will be inefficient and even counter-productive. It is argued that improvements in terms

[16] In their model, these mechanisms work through banks' balance sheets and entrepreneurs' financing conditions.

of financial stability might be achieved at the cost of higher inflation and macroeconomic instability. But also that tightening monetary policy may further increase the financial sector instability.

A monetary policy framework in which central banks are concerned with inflation and financial stability can generate a trade-off between these two objectives. As discussed in De Grauwe and Gros (2009), a trade-off between aggregate price and financial stability can arise in the context of technological shocks or “animal spirits”. In the event of a (positive) technological shock, inflation will tend to be lower than the targeted level (because the aggregate supply effect is higher than the demand effect), and asset prices will rise, reducing the cost of capital. In such a context, if the central bank cuts the interest rate in reaction to lower inflation, this will further increase asset prices and financial risks. De Nicolo et al. (2010) also support this view by highlighting that tighten the monetary policy stance when there is a rise in both inflation and risk taking will improve aggregate price stability and strengthen the stability of the financial environment. But if the economic context is characterized by high risk taking and low inflation, a trade-off can emerge. In the same line of arguments, Issing (2003) argues that a conflict between inflation and financial stability can emerge especially in the short term, even if the financial stability objective is assigned to another institution than the central bank.

In a DSGE model with a financial accelerator mechanism, Badarau and Popescu (2014) investigate the monetary policy optimality when the central bank has a financial stability objective in addition to the primary objective of aggregate price stability. Their results suggest that aggressive policy in the face of financial imbalances will only have little outcome in terms of response to a financial bubble. A trade-off can also occur between inflation stabilization and the credit cycle. According to Galì (2014), the hypothesis that tighter monetary policies can dampen the build-up of bubbles is not supported by the economic theory, especially when considering rational bubbles. Based on a theoretical model, this paper concludes that in response to an asset bubble, a systematic increase in interest rate will affect the bubble growth and increase its volatility.

King (2012) identifies three cases in which a trade-off can emerge between monetary and financial stability. The first one is the (too optimistic) misperception on the part of households, businesses and financial institutions about future incomes, leading to unsustainable spending and increase in the level of debt. Assuming that these misperceptions can be identified by the central bank, taking actions to correct them may generate a trade-off between stabilizing the financial system and hitting the inflation target. The second, referred to as the "cycle of confidence" suggests that prolonged periods of stability (both macroeconomic and financial stability) can encourage exuberant behaviors on the credit market for example, and generate subsequent instability. In the third case, trade-offs can appear due to the risk-taking channel, as described earlier. King (2012) further points out that, compared to the traditional Taylor curve[17] which reflects inflation and output volatility, adding financial shocks moves the frontier upper and to the right (what he calls the Minsky-Taylor frontier). In other words, adding financial stability to the traditional macroeconomic stabilization objectives increases the volatility of both inflation and output.

In addition to the above limitations underlined in the literature and stressing that the traditional central banking framework may face a dilemma when taking actions to deal with financial stability concerns, other arguments can be put forward to further highlight the difficulty to deal with financial imbalances in the standard monetary policy-making.

A first argument is related to the extent to which financial bubbles can actually be detected. Indeed, assuming that the central bank should respond or attempt to contain bubbles, the monetary authorities should be able to monitor the financial sector and especially identify asset prices deviations from their fundamental values. However, it may be argue that bubbles are difficult to detect. It is not straightforward to know for sure if a given change in asset prices is caused by changes in the asset's fundamental or non-fundamental factors. This complication can be perceived as a drawback for possible central banks' actions to tackle financial instability. But against this view, it may also be claimed that although not obvious, financial bubbles can be identified or tracked down through other more easily observable variables. As we discuss in more details in chapter IV, credit aggregates for example have been pointed in the literature as reliable indicators of potential asset price inflations.

[17] The Taylor curve depicts the standard central bank's objectives, namely inflation and output stabilization, and suggests that a trade-off can emerge between these objectives in the context of supply shocks.

A second set of arguments may be related to the effectiveness of the monetary policy instrument, the policy short term interest rate, in improving the financial sector stability. The central banks' main instrument might be inefficient in dealing with financial risks because an increase in the short term interest rate can have adverse effects in the sense that it may raise some assets' return, leading to further increasing risks through higher demand which may increase the asset price and generate a bubble. Tightening monetary policy may also have undesirable consequences for the overall economic activity since it may generate depressing effects on the economic growth. Focusing on the financial environment, the central bank instrument can appear to be too blunt to be effective in dealing with a particular source of financial instability. Financial risks can emerge from a specific sector of the financial system. Yet, the short term interest rate cannot target a particular set of assets for example, or a particular category of financial activities (which may be perceived as bearing important risks for the financial sector) without affecting the rest of the financial system.

The third argument we discuss is related to a comparative analysis of the potential costs associated with preemptive central banks' responses to a financial risk, compared to those associated with a crisis, *i.e.* when the risk materializes. On the one hand, the monetary authorities can always undertake drastic cuts in the interest rate when the bubble has burst, in order to avoid huge financial and macroeconomic costs (of course, the main limitation of such a strategy is the zero lower bound). The preemptive central banks response to financial imbalances, through tightening monetary policy can be detrimental for the real economy and even increase financial instability, as discussed above. These costs might be higher than those occurring following the crisis and central banks' actions to support the economic activity. This comparative analysis of the costs associated with precautionary central banks' actions has been pointed up in the "lean" versus "clean" debate regarding the role of monetary policy, especially before the 2008/2009 financial crisis. The Federal Reserve under Greenspan seemed to have been more inclined to the "cleaning" view, suggesting that central banks should not respond to financial bubbles but rather clean up after they burst (the so-called "Greenspan put").

Finally, it may be argued that the monetary policy credibility can be affected by a framework in which the central bank is concerned with other issues than its standard policy objectives. Reacting to financial instability can blur the economic agents' perception of central bank's inflation stability objective, and therefore affecting its credibility. Besides, according to the Tinbergen principle, the single monetary policy instrument (the short term rate) should be assigned to a single objective. Relying on this instrument as a means of achieving both macroeconomic and financial stability objectives is likely to be harmful for the central bank's credibility and its ability to meet these goals. However, this issue might be tackled by a clear definition of the monetary policy objectives (which may include a financial stability objective), or through higher transparence and strong communication in the monetary policy-making (for example, when needed, provide a clear justification of potential deviations from the inflation target because of financial instability concerns).

These limitations regarding the ability of central banks to deal with financial instability have put forward the need for a broader framework to tackle this issue. This is commonly referred to as macroprudential policies.

IV. The macroprudential framework

This section discusses some key features of the macroprudential framework. It provides a definition and stresses the main objectives of macroprudential policy. It discusses issues related to the assessment financial risks, the set of instruments available to the prudential authority to achieve its financial stability goal, and the effectiveness of macroprudential policy, as suggested by the existing literature.

IV.1. Macroprudential policy: definition and objectives

Prudential policies have been subject to increasing interest recently (Borio and Shim, 2007) since it turns out that, contrary to the conventional wisdom, financial risks can emerge and grow significantly even in context of low and stable inflation. Furthermore, the economic globalization might have driven two main forces which certainly exacerbated this paradox in some economies. On the one hand, globalization may have generated positive supply shocks, inducing downward pressure on aggregate price, thereby enhancing the central bank's credibility on its inflation stabilization objective. But on the other hand, asset prices have increased and were further boosted by the central banks measures against deflationary risks (loose monetary policies).

The 2008/2009 financial crisis has revived the debate on the relevance of a broader and more integrated framework to deal with financial instability. While so far monetary authorities were not so much concerned with this issue, the regulatory authorities in charge of the financial system's surveillance were mainly focused on the micro level of financial regulation (Basel II framework). The "bottom – up" approach followed by the microprudential supervision framework relies on the assumption that if financial institutions are individually healthy, the whole financial sector can be considered as stable. The crisis has shown that microprudential policies are certainly ineffective or at least not sufficient for a sound financial system. Particularly, the increasing interconnections between financial institutions, the closer linkage between financial activities and the real economy, and the intensification of the financial globalization are not taken into account in the microprudential framework. Macroprudential policies are rather conducted following a "top – down" approach which provides room to take account of these features (Table I.1 summarizes some important characteristics of micro versus macroprudential policies).

Table I.1: Micro versus macroprudential policy

	Macroprudential	**Microprudential**
Proximate objective	Limit financial system-wide distress	Limit distress of individual institutions
Ultimate objective	Limit the risk of financial distress with significant losses in terms of output	Consumer (investor/depositor) protection
Model of risk	"Endogenous" (dependent on collective behavior)	"Exogenous" (independent of individual agents' behavior)
Correlation and common exposure across institutions	Important	Irrelevant
Calibration of prudential controls	In terms of system-wide risk; top-down	In terms of risks of individual institutions; bottom-up

Source: Borio (2003)

In a broader perspective, macroprudential policy can be defined as the use of primarily prudential tools to limit systemic risk (IMF, 2013a); with systemic risk characterizing the risk of disruptions to the provision of financial services that is caused by an impairment of all or parts of the financial system, and which can seriously deteriorate the real economic activity. As discussed above, this definition stresses the importance to take account of the interconnections between financial institutions or different components of the financial sector, but also the connection between the financial sector and the real economy.

Regarding the main objectives or goals of the macroprudential policy, they can be highlighted through three main dimensions which stress the importance of, and characterize the consideration for system-wide analysis of the financial conditions. The first dimension basically refers to the need to strengthen the financial institutions' ability cope with a shock when the crisis materializes. In this regard, macroprudential policy aims at ensuring that those institutions build enough buffers during calm period in order to absorb the effects of a potential negative shock and preserve the stability (or at least avoid the breakdown) of the overall financial system. The second dimension stresses the role of macroprudential policy in reducing the pro-cyclical character of financial risks. The purpose is to contain the increasing risk exposure over time which can be characterized by a strong correlation between credit and asset prices, excessive increase in leverage or high financial volatility. Finally, in the third dimension, macroprudential policy seeks to regulate vulnerabilities which may arise due to strong interconnections in the financial sector, and therefore reduce the risk of contagion in the case where a particular segment of the financial system (or a single "too important" financial institution) may be affected by an adverse shock.

Emphasizing three main lessons from the global financial crisis, Hahm et al. (2012) also highlight the relevance of macroprudential instruments. The first lesson points out that the impact of developments in the financial sector on the economic activity is much more important than recognized so far. Second, they argue that it can be extremely costly to clean up after a crisis. The economic costs of financial crises are high in terms of losses in GDP growth, higher fiscal deficit, and the difficulty for central banks to break the spiral of unconventional measures undertaken to support the economy, which can impair their future ability and credibility in managing the economic activity. And third, as already mentioned, they highlight the fact that controlling output and inflation is not enough for financial stability.

The implementation of macroprudential policies however requires a definition and a measurement of financial risks, the determination of appropriated instruments to be used, and an assessment of their effectiveness.

IV.2. Assessing financial risks

According to Agur and Sharma (2013), macroprudential policy should aim to "*limit systemic risk by finding ways to dampen the effects of business and financial cycles, to handle interconnectedness and the build-up of common exposures by institutions and market players, and to catch credit and asset bubbles in their infancy rather than having to deal with them when they are considerably distended and their puncturing may lead to much economic and financial mayhem*". To be effective in achieving this goal, the regulatory authority should be able to clearly identify, measure and assess the level of financial risks. But it seems to be no common or unique definition of the risk. As pointed out by Galati and Moessner (2013), "*macroprudential policy is seen as aiming at financial stability but there is no commonly shared definition of financial stability*". Depending on countries and the economic environment, sources of financial instability may differ considerably, demanding as a consequence appropriate responses from the regulatory authority.

Effective investigation of financial risks should go beyond individual institutions' considerations and assess the systematic risk, which takes account of the interconnections between these institutions and the strong linkages between financial assets. As discussed earlier, the risk assessment should also include the interdependence between the financial system and the real economy. The dynamic evaluation of the financial risk is also fundamental (although difficult to address) because, considering the system, it is necessary to analyze the evolution of the correlation among financial institutions and the changes in interactions between the financial system and the economic activity. As regard individual institutions, it involves assessing the dynamic of the correlation between borrowers in addition to the changes in the riskiness of each institution. Another important feature of financial risks is their pro-cyclical character. Financial imbalances usually increase in period of good growth performances, making it less easy to accurately measure the level of the risk.

This pro-cyclicality might be further reinforced by the underestimation and misperception of the financial risk. According to Borio et al. (2001), possible factors leading to risk misestimation includes the use of wrong models to assess the economic and financial environment, and the cognitive bias ("disaster myopia" and "cognitive dissonance").[18]

As far as the measurement of risk is concerned, Borio and Shim (2007) argue that quantitative analyses proceed in three main ways: enhancement of data quality and availability, development of macro stress tests, and development of early warning indicators. An important and growing strand of the recent literature discusses and provides various measures of financial risks. At the macro level, the credit to economy is undoubtedly one of the most regarded indicators of financial risk. Rapid increase in credit to the private sector is usually accompanied with deterioration in the credit standards and increasing risk taking. Besides, increase in credit can feed financial bubbles by raising assets prices which will further lead the higher credit demand. Hahm et al. (2012) point out that "credit-driven bubbles" should be given special attention because they are the most dangerous. However, determining the level of credit which can be considered as describing a financial risk is another particularly tricky issue. The challenge is to disentangle the credit growth driven by economic fundamentals from the one which describes financial imbalances. A recent study from the BIS points out that for a better assessment of credit-driven risks, not only the banking system's credit to the private non-financial sector should be considered, but rather all sources of credit (Drehmann, 2013).

Another indicator of financial risk monitored is asset price, and specially deviation of asset price from the fundamental value. Real estate prices have been one of the major signs of the recent subprime crisis. As it may serve as collateral for households' borrowing, the increase in real estate value may increase credit demand and further increase the total private credit in the economy, leading ultimately to a higher financial risk. Financial asset prices are also informative regarding the health of the financial system. Besides, as pointed out by Park (2011), financial assets and real estates are of different nature and can be substitutes for one

[18] The disaster myopia is the predisposition of economic agents to underestimate the likelihood that events generating high losses can occur. Cognitive dissonance expresses the tendency to biased interpretation of information, reinforcing the prevailing belief of economic agents.

another. This strengthens the complexity of the monitoring process and requires more targeted instruments.

In addition to indicators of financial risk discussed above, many other can be mentioned, including excessive growth in the banking sector assets, the growth in some components of the banking sector's core or non-core liabilities (Hahm et al., 2012), indicators measuring the cross-exposures of financial institutions such as the CoVar (Adrian and Brunnermeier, 2009). The more recent literature also developed new methods based on network analyses to assess the risk from interconnectedness between financial institutions.[19] More specific indicators at the micro level can be related to banks' balance sheet or households' financial conditions, and others at the macro level related to exposure to global international shocks (currency, maturity, external assets/liabilities mismatches). Since it is hard to individually assess all the possible indicators of financial risk, Arregui et al. (2013a) argue that the supervisor should target intermediate indicators which may reflect growing risks from various sources, and which can be more easily affected by the available policy instruments. Another important concern highlighted by the recent crisis is related to financial innovations. The increasing sophistication of financial instruments makes the risk assessment more puzzling. Therefore, for financial regulation to be effective, the regulator should also be able to identify risks arising from these new developments in the financial sector and which can lead to rapid change in risk-concentration, increasing exposure to tail risks for some institutions whose size and interconnectedness make them "too important to fail".

Now that the financial sector is recovering from the late 2000s crisis, a new challenge for financial regulation seems to emerge. Indeed, a large part of the market and liquidity risk has migrated to the non-banking sector (the "shadow banking" sector). This shadow banking seems to embody an increasing part of financial activities traditionally provided by banks (according to IMF analyses, the shadow banking is now larger than the standard banking sector in the U.S., while about half the size in Europe). This raises an important issue for financial regulation since this part of the financial system is more opaque and much less

[19] See Arregui et al. (2013b) for a more detailed discussion on tools used to identify and measure risks related to interconnectedness.

regulated. The IMF has recently pointed this out as an important issue in the agenda of future financial reforms.[20]

The assessment and measurement of systemic risk is a key issue in designing the macroprudential framework. However, the system-wide risk approach is certainly limited by the lack of clear and precise definition, and measurement. A growing literature has recently attempted to provide various approaches to evaluate the systemic risk. Those approaches generally only take account of some specific aspects of the risk, related for instance to the contribution of an institution to the overall financial system's risk, or the risk related to the interconnection between those financial institutions. In spite of those improvements, much remain to be done in this area. According to IMF (2013a) further progress in assessing systemic risk is needed on three main areas. The first is the early warning. Indeed, the existing forward-looking properties of systemic risk measures do not seem to be satisfactory. The second is the determination of thresholds of perceived risks above which the regulator should be worried, and which requires taking necessary actions. Furthermore, the prudential authority may need to be able to monitor the impact of measures undertaken over time and potentially consider fine-tunings. And finally, the third is the ability of models to capture the system's behavior, including endogenous responses to the materialization of aggregate shocks and non-linearities in risk correlations.

Once financial risks can be identified and evaluated, the regulatory authority should determine the adequate response and appropriate instruments to be used.

IV.3. Prudential tools

For decades, it has seemed to be a large consensus among both academics and practitioners on the role of monetary policy, but also its main policy instruments. To achieve its goal of inflation stabilization, the central bank's primary tool is the short term interest rate which affects the real activity through various monetary policy transmission mechanisms. Other tools could be deployed in particular circumstances, to deal with irregular or exceptional economic conditions. These tools are referred to as unorthodox or unconventional measures,

[20] See the October 2, 2014 speech from Christine Lagarde (the managing director of the IMF) at the Georgetown University. Available at http://www.imf.org/external/np/speeches/2014/100214.htm.

and have been used by several central banks in the aftermath of the recent financial crisis, as discussed above. While this monetary policy toolkit appears commonly accepted, there is no such a consensus with respect to prudential instruments.

The financial risk assessment may take different forms, and indicators of risk may be more or less relevant depending on countries considered and the economic and financial context. Accordingly, prudential instruments should be suited to address the corresponding financial issue. Compared to the monetary policy toolkit, the macroprudential framework encompasses a larger set of instruments which are intended to deal with specific financial imbalances or risks. Considering the case of emerging countries which are subject to relatively important flows of international capitals, prudential tools designed to tackle risks related to currency mismatch may be desirable, while not necessarily relevant for high income economies. For the latter, prudential measures aiming to control financial innovations, and more generally financial markets are certainly more relevant, compared to emerging countries where financial markets are much less developed.

More specific prudential instruments are discussed among both researchers and policy-makers. In this work, we do not intend to provide an exhaustive list of those tools. Table I.2 rather provides some of the most relevant prudential instruments, mainly related to the banking sector, and their associated possible role. They are categorized by distinguishing between tools applied to lenders or financial institutions (including those targeting cross-section risks, those aiming to contain countercyclical financial risks, and those related to external or currency risks exposure), and tools which are more focused on borrowers.

Beyond those specific prudential measures, ensuring and strengthening the global financial stability is also a crucial concern, given the increasing global economic and financial integration. In this regard, a larger set of policies with specific objectives and tools should be considered. Microprudential policy should aim at limiting distress of individual financial institutions, relying on instruments such as quality or quantity of capital control, or leverage ratios. Macroprudential policy pursues the objective to limit the system-wide financial distress, with instruments including countercyclical capital charge or systemic capital charges. Monetary policy can play a dual role: maintain price stability relying mainly on the short term interest rate, and lean against financial imbalances using reserves requirements for example.

Table I.2: Selected prudential instruments

	Instruments	Possible role
	Cross-section risk management	
Constraints on financial institutions	Loan-to-deposit caps	- Restrain excessive assets growth by tying loan growth to the growth in deposit funding. - Affect the growth of non-core liabilities and hence the increasing vulnerabilities originating from the liabilities side of the banks' balance sheet.
	Levy on non-core liabilities	Mitigate pricing distortions that may lead to excessive assets growth, align incentives: - By varying over the financial cycle, the levy can act as an automatic stabilizer; - Address externalities associated with excessive assets growth and systemic risk arising from interconnectedness of banks; - When applied on foreign currency liabilities, address the vulnerabilities of sudden reversals in capital flows due to deleveraging by banks (particularly relevant for open EMEs).
	Forward-looking provisioning	Improve loss-absorbing buffer in the form of provision at the time of making the loan.

	Leverage caps	Limit assets growth by tying total assets to bank equity.
	Liquidity risk charges that penalize short-term funding	Limit the pro-cyclicality of financial risk in the banking sector.
	Capital insurance	Insurance that can be purchased by a bank and which pays off in a bad state of the world, according to a pre-specified trigger.
	Contingent reversibles	Debt securities that automatically convert into equity if the bank's regulatory capital falls below a fixed threshold.
	Capital surcharge	Increase resilience of too-big-to-fail institutions.
	Ceiling on credit or credit growth	Limit the risk related to excessive growth in credit.
	Warnings (speeches or financial stability reports)	Discretionary tools which can act as signals to the financial sector in periods of increasing risk.
Countercyclical risk management		
	Capital requirements that adjust over the cycle	During boom periods, the rise in assets value may support increase in lending, and during bust, the capital can drop precipitously, leading to cuts in lending. Capital requirements which adjust over the cycle can make the boom and bust less likely, promoting stability in lending.

	Capital conservation measures (limit on dividends payments, share buybacks, compensation paid out by financial institutions)	Build up excess capital during good times in order to absorb asset write-off in bad times.
	External or currency risk management	
	Explicit ceilings on foreign exchange derivatives positions of banks	- Mitigate excessive volatility of foreign capital flows. - Limit short term foreign currency denominated borrowing of banks.
	Regulation on foreign currency bank loans	
	Regulation to improve foreign exchange risk management in financial institutions	
	Unremunerated reserves requirements	Capital control instrument (when applied to capital importers). Acts like a tax on capital inflow.
Constraints on borrowers	Loan-to-value caps	- Help to limit the credit demand and non-performing loans. - Limit the amount of debt that can be used to finance an asset (help to lean against the rise in asset prices).
	Debt-to-income caps	

Sources: Ham et al (2012), Borio and Shim (2007), Hannoun (2010), Galati and Moessner (2011), IMF (2013a)

In addition to these two obvious policy frameworks, fiscal policy can also contribute to enhance financial stability.

More especially, financial stability can be affected by a range of policies other than macroprudential policy (IMF, 2013a). These other policies should therefore be set in a way that contribute to (or at least facilitate) the effectiveness of prudential measures in place. Precisely, as discussed above, monetary policy can generate conditions favorable to an increase in financial risk, even in a context of low and stable inflation. In small open economy, an increase in interest in response to inflation pressure can raise concerns for financial stability through a surge in capital inflows for example. On the contrary, cuts in the interest rate can lead to capital outflows which may also create further instability in the financial sector. On the other hand, effective macroprudential policy in place may ease the implementation of monetary policy by reducing the risk of conflict of objectives which may arise if the central bank has to deal with financial instability concerns, but also by preventing the risk that monetary policy runs into constraint in the face of an adverse financial shock. These arguments stress the relevance for a coordinated action between macroprudential and monetary policy. The two policies should work hand-in-hand in order to deliver the best achievement regarding their respective goal.

Fiscal policy is also likely to help improving the financial conditions and can strengthen the effectiveness of macroprudential policy. In the case of sharp increase in the aggregate demand, mainly driven by capital inflows and persistent current account imbalances, and which may raise concerns for financial stability, a sound fiscal policy may be required in addition to prudential measures to address this issue. Sustainable fiscal policy may also promote the effectiveness of macroprudential policy by reducing the risk of feedback loops between potential sovereign crisis and the financial system. Recent experiences have shown how a sovereign debt crisis can have strong and destabilizing effects on the financial sector. Furthermore, fiscal policy can manage aggregate demand through tax or automatic stabilizers, or by building fiscal buffers in good times through limitations on the level of debt (Hannoun, 2010).

IV.4. The effectiveness of macroprudential policy

Assessing the effectiveness of macroprudential policies is crucial because lessons can be learned from past experiences. The success of instruments constituting the policy toolkit in addressing the corresponding financial risks should be investigated. Contrary to monetary policy where the set of instruments is much more limited, prudential policy should be subject to a more regular monitoring to evaluate the adequacy of the supervisory decisions, and to fine tune the undertaken actions, if necessary.

Empirical investigations of the effects of macroprudential policies are scarce; the main reason being the lack of historical data on the implementation of prudential measures. Another obstacle to empirical analyses on macroprudential policies is the difficulty to get a quantitative measure of the related instruments. Most of the existing studies have been conducted at country specific levels and investigate the effect of a particular prudential instrument on a given source of financial risk. For the case of the Spanish banking sector, Jiménez and Saurina (2006) evidence a strong positive relationship between rapid credit growth and loans losses. They show that during lending boom, riskier borrowers obtain funds and collateralized requirements significantly decrease, leading to higher risk. Formally, their empirical investigation suggests that high credit growth during boom periods is positively correlated with bank non-performing loans and bank default probability. They further investigate the extent to which countercyclical prudential instruments can mitigate this effect. The purpose is to set up a prudential instrument in the form of loan loss provision, which includes a countercyclical component aiming to increase provision in period of rapid credit growth. They simulate the extent to which such a countercyclical requirement can be effective in mitigating the increasing risk during booms. Their findings suggest that countercyclical loan loss provisions can contribute to reinforce the banking sector stability and soundness.

Keys et al. (2009) investigate the effect of prudential regulations on the quality of mortgages loans originations in the U.S. Their findings suggest that the quality of loans origination is inversely correlated with the stringency of the regulation. However, market forces (more lenders inside the mortgage pool, suggesting higher diversity), some incentives to reduce risk taking, such as compensations of the top management of lenders, and stronger risk management in financial institutions (as suggested by the relative power of the risk manager and more stringent brokers regulation) succeed better to improve the quality of loans. Gauthier et al. (2012) test the effect of macroprudential capital requirement on the systemic risk. They find that financial stability can be enhanced by adopting systemic perspectives in regulating the financial system. Their analysis shows that capital requirement reduces the probability of individual bank's default and also decreases the probability of the occurrence of systemic financial crises by about 25%.

For cross countries analysis, the first relevant and comprehensive empirical study on a large sample is provided by Lim et al. (2011). Relying on data for 49 countries, they investigate the extent to which, and under which conditions some of the most common macroprudential instruments reduce the pro-cyclicality of the systemic risk. Prudential tools (particularly, caps on the loan-to-value ratio, caps on the debt-to-income ratio, ceilings on credit or credit growth, reserve requirements, countercyclical capital requirements and time-varying/dynamic provisioning) are found to help dampening the pro-cyclical financial risk. In addition, other measures such as limits on maturity mismatch, limits on net open currency positions / currency mismatch can mitigate the common exposure across markets and financial institutions. As regard the context of the implementation of these instruments, the paper argues that the exchange rate regime or the size of the financial sector does not affect the effectiveness of those prudential instruments. Maddaloni and Peydrò (2013) investigate the role of monetary and macroprudential policies on risk taking in the banking sector for the Euro area. Relying on an empirical analysis based on European banks, they find that before the 2008/2009 global financial crisis, a low interest rate in the monetary policy-making is associated with higher risk in the banking sector through softened lending conditions (the assessment of lending standards is derived from the Euro area's Bank Lending Survey). However, using an interactive variables approach, their empirical investigation suggests that this effect of monetary policy on lending standards is affected by the macroprudential framework. Especially, they evidence that measures on bank capital and loan-to-value ratio reduce the effect low policy interest rate on lending conditions.

Arregui et al. (2013) propose a framework for a rigorous investigation of the effectiveness of prudential policies. The methodology proceed in the following steps: the first issue is to determine when the regulatory authorities should act. In this respect, early warning indicators (intermediate targets) have to be scrutinized in order to evaluate the probability of crisis. The second step intends to design a simple framework to assess the net benefits of regulatory authorities' interventions to dampen the financial risks. Prudential measures, while preventing the financial system from crises, may also have a cost in terms of real activity (for example, cuts in credit supply may be detrimental for investment financing and therefore the economic activity). Third, the effectiveness of policy instrument in lowering the financial risk has to be evaluated. The purpose is to investigate the effect of policy instruments on the intermediate targets. The fourth step aims at evaluating the benefits of policy interventions in terms of financial stability, but also the losses in terms of real activity in event of crisis. In the fifth step, the cost of the intervention is estimated through the effect of change in the intermediate targets (due to policy actions) on the real activity. The paper also points some leakages which could hamper the effectiveness of prudential policies. These are related to shadow banking, foreign externalities (risk shifting to other countries), or structural distortions.

The literature also assesses the effectiveness of macroprudential policies in theoretical models. Benigno et al. (2010) assess quantitatively the existence of inefficient borrowing in business cycle, in a context of emerging countries with production and occasionally binding credit constraint. The main conclusion of this analysis is that there is no strong evidence of the gains of prudential policies ex-ante, compared to measures undertaken in crisis periods. The model developed by Korinek (2010) focuses on implications of risks related to capital flows for the stability of the financial system, in a context of a small open economy. The paper demonstrates that increase in capital outflows due to a depreciation effect is not internalized by decentralized agent during hard time (financial crisis). It finds that risk-adjusted capital flows regulation (in the form Pigovian tax on capital inflows) can lead to a better outcome in terms of macroeconomic volatility and financial stability. The quantitative analysis reveals that the tax can range from zero for foreign direct investments to 1.54% for foreign currency denominated debt.

Relying on a two-sector DSGE model with a systemic credit externality, Bianchi (2011) investigate the extent to which raising the cost of borrowing can decrease the risk taking and enhance financial stability. It is hypothesized that during tranquil period, agents do not internalize the externality related to the financial accelerator effect. The paper concludes that implementing a tax on debt has a positive welfare effect, as it restores constrained efficiency, reduces agents' incentives for over-borrowing and the incidence and the severity of a financial crisis. Agénor et al. (2013) examine the role of monetary policy and capital regulation on macroeconomic and financial stability. Their theoretical analysis relies on an extended new Keynesian model where macroeconomic stability is captured by the volatility of both inflation and output gap, while financial stability is measured through credit to GDP ratio, house price and loan spread. The main conclusion of the paper is that combining monetary policy interventions to maintain inflation stability with credit-augmented interest rate rule and countercyclical capital regulation may be optimal to enhance both macroeconomic and financial stability.

So far, we discussed the relevance of macroprudential policy, prudential instruments and their effectiveness in dealing with financial risk. But we left aside institutional concerns which may be related to the implementation of the prudential framework. The next section is devoted to these issues.

V. Institutional arrangements

Financial stability plays an important role in the financial system and contributes to ensure a sound macroeconomic environment. Strengthening financial stability is crucial to avoid recurrent financial crises and reinforce the overall economic stability. In this respect, the need to consider the financial system at the macro level (and not only at the individual institution's level) is now broadly accepted as the best approach to assess and address financial risks. However, there is no such a consensus regarding the institutional framework which should guide the implementation of the prudential regulation. This section starts by discussing the "rule" versus "discretion" approaches of the prudential policy and then, the institutional setup and governance issues.

V.1. "Rule" versus "discretion"

The previous section provides a review of some prudential instruments which have been found to be effective in mitigating financial risks. A key issue in the calibration of these tools is whether the regulatory authority should conduct its policy discretionarily or following a rule-based strategy.

Within the rule based policy, the regulatory authority sets ex-ante conditions under which the policy instruments evolve (can be refer to as “built-in stabilizers”). It should be able to specify ex-ante the policy actions which will be undertaken in the advent of certain events. The framework is therefore expected to be described by consistent reactions of the policy instruments to observables events, characterizing changes in financial risks. The policy instruments’ setting is expected to be more systematic and more predictable. The regulator can also discuss its policy strategy in more dynamic terms, for example by taking account of the implications of today’s decisions on decisions in the future.

The main advantage of this approach is that it sends a broader signal to private agents and financial institutions, about the authority’s concern with financial stability. It acts as pre-commitment device, since, once implemented, there is no need for the regulator to recurrently justify some changes in the prudential instruments. It can also have the advantage to be strongly related to various aspects of financial imbalances, and, given the automatic adjustment of the existing instruments, it leaves less room for policy misjudgments. By their automatic nature, rule-based policies certainly relax the pressure on the regulator from the political institutions and markets, regarding the reluctance to take countercyclical actions during economic booms. The best prudential tools for rule-based policy will intend to improve the risk management through better practice in terms of policy-making. These include: loan provisions, minimum capital requirement, loan-to-value ratio, and prudential measures addressing currency mismatch (Borio and Shim, 2007).

The conduct of the prudential policy following a rule however has some drawbacks. The main shortcoming may be related to the foundation of the credibility of such a framework: detect “bad” events and undertake necessary actions. As we discuss earlier, it is difficult to identify bubbles (the “event”). Various indicators can be used to assess the state of the financial system and to measure the risk. The desirable action to be undertaken is also an important issue since it requires a good calibration of prudential instruments at the disposal of the regulator. As noted in Agur and Sharma (2013), a parallel can be drawn with monetary policy. While for monetary policy the event (a rise in inflation above the target) and the action (tightening monetary policy through an increase in interest rate) are quite clear, there are no such well-defined circumstances regarding macroprudential policies and their financial stability objective.

Contrary to the rule based approach, a discretionary policy setup of the prudential regulation leaves room to the regulatory authority for the implementation of the prudential policy without committing ex-ante to a specified rule. The supervisory authority decides when and to what extent any action should be undertaken, discretionarily. Decisions are more ad hoc and much less predictable since they are more focused on short term adjustments.

The main benefit of discretion-based policies is that the prudential actions can be better fine-tuned. This might be useful because financial imbalances are infrequent and can show up with various intensities depending on the financial sector considered, the economic cycle, etc… In this regards, the scoop to fine tune the prudential instrument may be desirable to be effective and to deliver the expected outcome. Discretionary measures can include: warnings, supervisory reviews, or quantitative adjustments of various instruments.

As for rule-based policy, the discretionary policy framework has its own cons. The first, and certainly the main drawback of discretion is that the regulator can be more subject to politic or lobby influence. A reason for the latters to try to influence the regulator can be related to the fact that prudential measures may be targeted to a particular sector of the financial system, raising resistance from the part of some financial stakeholders who may highlight particular circumstances (or inaccurate or mistaken analysis and judgment from the regulator) that do not require stringent actions. This effect may be stronger if the given sector is highly concentrated. Another drawback of discretion is that the regulator do not necessarily have more reliable information than the market participants, about the built up of financial imbalances. In that sense, discretionary measures can be ineffective in dealing with increasing risks.

In practice, the distinction between rule and discretion in the macroprudential policy-setting (as in the monetary policy-making) may be more a matter of degree, rather than a perception of strict and extreme opposition of two policy frameworks. Furthermore, the two approaches are not exclusive from each other. While rule based policy seems to be superior, the regulator may need a room for maneuver for discretionary interventions in some circumstances. As reported in Agur and Sharma (2013) the Bank of England seems to implement a mix of the two strategies. One of the main advantages of a rule based approach is that it is better suited to overcome political economy challenges. Nevertheless, as the existing risk indicators are unlikely to capture all information, and given that the sources of risk can shift over time, macroprudential policy might be better supported by a "guided discretion" policy approach where some key indicators can help signal the need for adjustments, but the policy decision is based on judgments which take account of broader information (IMF 2014f).

V.2. Governance issues

Determining the authority which should be in charge of the prudential policy is another important issue in the macroprudential policy setup. While the macroprudential policy's objective is quite clear and commonly accepted, the question of the appropriate institution to carry out this task is still subject to debate. A clear-cut consensus does not seem to emerge from the existing literature. Policy-makers do not seem to either converge toward a same institutional architecture. The concern is whether central banks should be in charge of the financial stability objective (in addition to its primary objective of inflation stabilization) or this has to be assigned to a separate authority.

The central bank model

There are arguments in favor of a centralization of both inflation and financial stability objectives into central banks' hands. According to Blanchard et al. (2010), central banks are best suited to manage the financial regulation because, as institution in charge of monetary regulation, they are certainly in a better position to monitor the macroeconomic developments and particularly those related to the macro-financial sector. Besides, in some countries (especially in emerging market economies), central banks are already authorities responsible for the banking sector regulation (*e.g.* China, Malaysia, Singapore, Vietnam – Lim et al., 2013).[21] Moreover, it can be argued that coordination problems may arise if a separate institution is in charge of the financial sector's regulation. This can generate communication issues which may be particularly harmful in period of high financial instability. Finally, given that the monetary policy decisions affect the financial system, a centralized framework where a single institution (the central bank) is in charge of both the monetary policy-making and the financial system regulation may be more effective. Yilmaz (2011) summarizes advantages to

[21] Within the euro area, the ECB is also the institution in charge of financial regulation through three European Supervisory Authorities (the European Banking Authority, the European Securities and Markets Authority, and the European Insurance and Occupational Pensions Authority) and the European Systemic Risk Board.

assign the financial stability objective to central banks through the following statement: "*no coordination problem, more effective communication under one voice, and swift response to emergencies*".

But the central bank model is likely to raise some concerns. One of those has to do with the central bank independence. If a single institution is in charge of macroeconomic stability and financial regulation, the needed instruments to achieve these goals may require stronger coordination between this institution and the government (an argument to legitimate such a stronger reliance on the political authority might be related to the fact that too much power is concentrated into a single institution's hands). That may be detrimental for the institution's independence (Yilmaz, 2011). Another possible drawback of the central bank model is the possible trade-off between financial and inflation stability objectives. This will however strongly depend on instruments used to achieve these two policy objectives, but also on the nature of the shock. As discussed earlier, in the event of supply shocks, if the central bank relies on the short term interest rate as primary instrument, the two objectives may be conflicting because raising the interest rate to dampen an increase in asset prices will lead to deflationary risks and potentially depress the economic activity.

The separate institution model

In this framework, central bank remains in charge of the monetary policy-making with the standard inflation (and output gap) stability objective(s), but the financial sector regulation is under the responsibility of a separate institution.[22] A straightforward advantage of such a framework is that each institution will be focused on its own objective, avoiding a possible trade-off. The main drawbacks of the separate institution model can be derived from advantages of the central bank model. The regulatory authority may lack central banks' experience in monitoring the changes in the macroeconomic conditions. Depending on the prevailing economic environment and measures undertaken by each institution, the two authorities' actions may be conflicting, if not coordinated. Besides, the extent to which each authority will be effective in achieving its objective may be affected by the policy conducted by the other. For example, faced with an increase in asset prices, the prudential regulator may

[22] While in most cases financial regulation is under a single supervisor authority, there may be frameworks where multiple institutions are in charge of particular sectors of the financial system.

take actions to contain the financial risk. But, if at the same time the central bank is implementing an accommodative monetary policy, the prudential intervention may be less likely to be effective.

The above mentioned cons of the separate institution model highlight the need for coordination and cooperation between the central bank and the regulatory authority in this framework. As reported by the governor of the Sveriges Riksbank, the use of macroprudential and monetary policies instruments should be coordinated for at least three reasons. First, since these instruments can be conflicting, there is danger if they are implemented in an uncoordinated manner. Second, macroprudential and monetary policy instruments generally reinforce each other. To ensure optimal outcome with the two policies, it is necessary to assess and understand the overlap between their instruments. Finally, to reach their respective objectives, the central bank and the financial regulator may need to work together because their sole instruments might be insufficient to meet the target. Close coordination will be required to guide the calibration of their instruments (Ingves, 2011).

An intermediate institutional arrangement, between the two "extreme" cases discussed above might be a framework in which prudential regulation is assigned to a dedicated committee under the roof of the central bank.[23] Such a structure may be convenient in the sense that that the regulatory authority can benefit from the central bank's policy-making experience. This may ease the coordination between the two policies. Such a framework is also likely to reduce the risk of dual mandates for the central bank, and may help managing the power that has been assigned to the central bank, therefore reducing the risk of political influence with respect to the central bank independence.

The institutional arrangement can play a crucial role for the appropriate use of macroprudential instruments. Lim et al. (2013) argue that the institutional arrangement can affect the timeliness of the implementation of prudential tools if it facilitates the systemic risk monitoring and identification, and if it fosters cross-agency policy coordination. The paper empirically investigates this relation and proposes three indexes capturing the institutional arrangement (one of those indexes highlights the role of the central bank in the macroprudential regulation setup, a second, the role of central bank in the microprudential

[23] It is the case in the U.K. for example for the Prudential Regulation Authority.

framework, and a third, the role of the government in the macroprudential regulation). Based on a sample of 39 countries, the results suggest that giving the central bank an important role in the prudential policy-making enhance the timing of the response to increasing financial risks. It also seems to be a positive correlation between changes in the monetary policy interest rate and the response time of the macroprudential policy, highlighting the relevance of coordinated actions between the two policies.

Choosing an institutional arrangement against another will certainly depend on countries' economic, political and historical characteristics. Studying the prudential frameworks in Asian countries, Lim et al. (2013) provide some evidences in this respect. Their analysis shows that the size of the economy is an important determinant of the institutional framework prevailing for the monetary and prudential policies setup. Small and more open economies tend to be inclined to central bank models, while more developed countries adopt the separate regulator model. The countries' political and legal environment also matter for the prudential institutional arrangement. Besides, countries' history and crises experiences tend to influence the formation and the structure of regulatory or supervisory agencies.

VI. Conclusion and way forward

This chapter aims to assess and provide some insights on the nexus between monetary policy and financial stability. It also provides a broad discussion related to the more recent and growing debate regarding the relevance of macroprudential policies as a framework to deal with financial imbalances.

The global financial crisis seems to have stressed some weaknesses of the monetary policy doctrine which has prevailed in recent decades. The consequences of the crisis somehow point the need to reconsider the prevailing consensus on the relationship between the monetary policy-making and the stability of the financial system. The monetary policy stance can affect developments in the financial sector since it influences economic agents' risk taking behaviors. In such a context, central banks have a major role to play in ensuring or strengthening the financial system stability. Their actions are however certainly limited given the primary mandate of aggregate price stability, but also limitations in the effectiveness of their main policy instrument, the short term rate, in addressing or avoiding (specific) systemic risks.

A broader framework, consisting of a larger set of instruments which can be targeted to various sources of financial risks seems to be required, as discussed extensively in the recent literature. Macroprudential policies are already in place in number of countries. But contrary to the monetary policy-making in which a large consensus has emerged regarding the best practice, there is not yet such a clear picture for the implementation of prudential policies. Some relevant issues remain to be address.

The role of macroprudential policies is to avoid financial crises (with potential important consequences in terms of real activity) by controlling financial imbalances or financial risks. However, there is no consensus on the definition and measurement of financial instability. A number of studies provide various methods to assess and measure the level of risk in the financial sector, but a commonly accepted approach does not emerge.

There are little evidences on the effectiveness of macroprudential instruments in dealing with the targeted financial risks. This is due to the relatively recent implementation of these strategies and the lack of historical data. Reliable data and more accurate investigations are needed to learn lessons from existing experiences and enhance the macroprudential policy setting.

The institutional arrangement is another critical issue for the conduct and the effectiveness of macroprudential policies. While it is clear that central banks have a crucial role to play, some arguments suggest that a separate institution should be in charge of the implementation of the prudential policy. Whether the strategy should be rule-based or discretionary is another concern. There is certainly not a clear and definitive best institutional practice. This might rather depend on the country's specific characteristics regarding the monetary policy, but also the financial and macroeconomic environment.

Other relevant issues, necessary for the financial sector regulation to be effective are related to the increasing importance of the shadow banking and the multilateral coordination of prudential policies. As mentioned in this chapter, the shadow banking is gaining importance in the current financial environment, suggesting a risk shifting to this under-regulated segment of the financial system. A challenge for the prudential regulator is therefore to increase the vigilance on shadow banking activities, assess the extent to which those activities may increasing the system-wide risk, and if necessary, improve the control and the regulation framework.

A multilateral perspective of prudential policies is needed, given the increasing financial integration. In a globally integrated financial system, additional concerns arise because optimal prudential regulation at the country level may be suboptimal at the global level. In this regard, macroprudential frameworks should be designed to reinforce not only the domestic but also the global financial stability. When setting a prudential policy, an assessment of its impact on the domestic country's economic and financial environment, but also the impact on the country's external balance sheet as well as potential spillovers effects analysis, is required. In this respect, effective prudential policies can be expected to have positive spillover effects on other countries.

Internal prudential measures can also generate adverse spillover effects for financial stability in rest of the world, or the main country-partners. For example, domestic constraints aiming to contain the risk by restricting the credit supply may increase cross-border loan provision. Measures undertaken to reinforce the domestic financial institutions' resilience to shocks may cause the latter to move their activities in other countries, where financial regulation is potentially less restrictive. Besides, the lack of an effective domestic prudential framework can increase the risk that a crisis emerge, and potentially generates negative externalities for the other economies. In this regard, cross-border coordination of prudential policies is needed to avoid those concerns and strengthen the financial system at the global level. A very recent strand of the literature attempts to formally investigate the relevance for an international coordination of macroprudential policies and conclude to increase in welfare gains. Those studies rely on theoretical frameworks and especially on two-country DSGE models (see for example Poutineau and Vermandel, 2014).

This chapter provides some insights stressed in the existing literature and suggesting that monetary policy frameworks guided by inflation stabilization as the main objective for the central bank, are likely to be associated with an increase in the financial sector fragility, and higher likelihood of crisis. Besides, this argumentation also suggests that such monetary policy frameworks are less likely to respond timely and accurately to financial shocks because the latters may arise in an environment characterized by low and stable inflation, therefore refraining the need for the monetary authority to take actions. Following this discussion, the two subsequent chapters assess more closely the relationship between the inflation targeting strategy (a monetary policy framework characterized by a strong commitment to inflation stability as the primary central bank's objective) and financial crises / instability. Precisely, the next chapter explores the extent to which inflation targeting countries have been more affected by the 2008/2009 financial crisis, while chapter III investigates whether inflation targeting central banks are less concerned with financial risks in their policy-setting, making their financial system more fragile compared to others.

Chapter II

Coping with the Financial Crisis: did Inflation Targeting Make any Difference?*

"*Today, inflation targeting is being put to the test – and it will almost certainly fail.*" (Stiglitz, 2008)

I. Introduction

The U.S. financial market has recently faced an exceptionally large shock, originating particularly from the subprime market. The so-called subprime crisis has spread primarily to the other high income countries' financial sectors (due to the high degree of financial integration among the most developed economies), generating a global financial crisis. The effects of this crisis largely went beyond the financial sector and affected the real economy, causing large output losses and the related consequences in terms of employment. The issue of what caused the 2008/2009 financial crisis is subject to controversial debate. On the one hand, the monetary policy-making prevailing in the pre-crisis period has been criticized and even pointed as a main source of the recent global financial shock. Given that inflation stabilization was widely considered as the main central bank's objective, the low and stable

* A version of this chapter has been published in *International Economics, vol. 133(2013), p. 72-92*.

inflation rate during pre-crisis period (since the early 2000s) has been accompanied with accommodative monetary policies (especially in the U.S.) and increasing liquidity. This, in turn, may have encouraged credit demand since at the same time risk premium and interest rates were decreasing.

On the other hand, weaknesses regarding the control of financial innovations and the ineffectiveness of the financial regulation framework in place in the early 2000s are considered to be the main cause of the increase in financial risks that culminated into a global financial turmoil in 2008/2009 (see Dooley, 2010; Rose and Spiegel, 2009, among others). This financial crisis has been striking, by its scope, its spread at the global level, but also by its important effects on the real economic activity. Faced with such a global shock, an important issue is to investigate or to shed light on the most important countries' characteristics that can contribute to mitigate the resulting consequences. Recent empirical researches have assessed for example the extent to which some macroeconomic preconditions could have helped addressing the crisis (Blanchard et al., 2010; Lane and Milesi-Ferretti, 2011, among others). Above and beyond these particular macroeconomic conditions, another interesting concern is whether specific policy strategy/regime can be more resilient than others in limiting the losses during such a global shock. For example, the extent to which the exchange rate regime prevailing at the onset of a crisis can make a difference in mitigating its effects has been investigated in the literature (see for example Tsangarides, 2012 for the recent financial crisis). Such a concern regarding the monetary policy regime is much scarcer in the existing empirical research, and this chapter aims at contributing to fill this gap.

This chapter intends to assess the extent to which the monetary policy regime has made a difference regarding the countries' performances in dealing with the economic consequences of the 2008/2009 financial crisis. More especially, the purpose is whether countries that have adopted the inflation targeting strategy did better during this crisis. Inflation targeting is a relatively new monetary policy strategy which emerged in the early 1990s. Bernanke et al. (1999) define inflation targeting as "*a framework for monetary policy characterized by the public announcement of official quantitative targets (or target ranges) for inflation over one or more time horizons, and by explicit acknowledgement that low, stable inflation is monetary policy's primary long-run goal*". The macroeconomic performances of this monetary policy regime (compared to alternative strategies) have been largely investigated in the empirical literature. Although some studies concludes that inflation targeting does not improve the control of inflation in countries that have adopted it (see for example Ball and Sheridan, 2005), this literature, to a large extent, provides evidences that inflation targeting central banks succeed better than the others in lowering both the level and the volatility of inflation (Vega and Winkelried, 2005; Mishkin and Schmidt-Hebbel, 2007; Gonçalves and Salles, 2008; Lin and Ye, 2009, among others). The inflation targeting regime is also found to improve central bank credibility (Johnson, 2002, 2003; Levin et al., 2004), fiscal stance (Abo-Zaid and Tuzemen, 2012; Lucotte, 2012; Minea and Tapsoba; 2014), external position (Rose, 2007; Lin, 2010), or country risk premium (Fouejieu and Roger, 2013). Despite this extensive research on the effect of inflation targeting, much less has been done so far on its relative performances in crisis periods.

The analysis conducted in this chapter is a contribution to the relatively scarce literature on the performance of inflation targeting in context of economic shocks. Two research papers investigate this issue in the particular case of oil prices shocks, namely Neumann and Von Hagen (2002), and Mishkin and Schmidt-Hebbel (2007). Neumann and Von Hagen (2002) compare targeting and non-targeting countries (in terms of inflation, long term and short term interest rates) during the 1978 and 1998 oil prices shocks. Using the difference in difference approach, their conclusions suggest that the increase in both short and long term interest rates has been significantly lower in targeting countries. Regarding the inflation performances, there is no significant difference between the two groups. The main hypothesis in Mishkin and Schmidt-Hebbel (2007) is that, if the inflation targeting regime increases the central bank credibility in anchoring price expectations, inflation performances in targeting countries can be expected to be better during oil price shocks. Targeters can also be expected to better mitigate the consequences of such shocks that can translate through the exchange rate. Their empirical assessment based on a panel VAR approach also concludes in favor of inflation targeting. Mishkin and Schmidt-Hebbel (2007) further assess the extent to which inflation targeting can reduce the responses of domestic interest rates to changes in international interest rates. They provide evidence that inflation targeters are more insulated to the international interest rates fluctuations.

The above two studies can be considered as leading researches regarding the comparative achievements of inflation targeting in particular circumstances of economic shocks. However, one main limitation of these empirical analyses is that the shock intervenes in early periods following the inception of inflation targeting. The relatively short experience in the implementation of inflation targeting is likely to reduce the accurateness of empirical investigations on its comparative performances. More importantly, no emerging market inflation targeters can be included in these analyses, as most of those countries have adopted the strategy later in the late 1990s or early 2000s. In this regards, the recent financial crisis offers an unprecedented opportunity for more rigorous investigations. Faced with the 2008/2009 financial crisis, de Carvalho Filho (2010, 2011) assess the extent to which targeting countries have performed better. Relying on a cross-sectional analysis based on a sample of 51 advanced and developing countries, including 23 inflation targeters, de Carvalho Filho (2011) finds that countries that have adopted the inflation targeting monetary policy strategy have registered lower output losses during the crisis.

In this chapter, we provide a rigorous approach to investigate the comparative economic performances between targeters and non-targeters during the 2008/2009 financial crisis. First, we discuss the economic intuition underlying the assumption that inflation targeters can be expected to do better in mitigating the effects of such a crisis. Our argumentation is based on the existing literature on the macroeconomic performances of inflation targeting, and the literature on the determinants of countries' resilience to the crisis. From these two strands of the literature, it can be argued that targeting countries are expected to perform better in coping with the crisis thanks to better initial macroeconomic conditions (including better fiscal and external positions, lower debt and lower exchange rate volatility), but also thanks to higher central bank credibility and higher initial policy rates which provides more room for monetary policy easing when needed. Second, our empirical investigation relies on a more rigorous approach in the spirit of Ball and Sheridan (2005). Applying the difference in difference method, our approach aims at avoiding a potential bias in the estimation of the effect of the inflation targeting regime, which can arise from differences in the initial conditions due to the implementation of this strategy in some countries. Third, contrary to de Carvalho Fliho (2011), our empirical tests do not focus solely on estimating the effect of inflation targeting on the change in the GDP growth during the crisis. We assess the comparative performances of targeting and non-targeting countries in terms of (1) central banks achievements in mitigating "deflation scares", in avoiding sharp increases in inflation volatility and real interest rates, in lowering their policy rates; but also in terms of (2) more general economic performances regarding output losses during the crisis.

The analysis is based on a sample of 67 advanced and developing countries, including 20 inflation targeters, over the period 2003 to 2009. Our main findings suggest that targeting central banks (especially in developed countries) have significantly performed better in mitigating the rise in inflation volatility during the crisis. However, no difference seems to emerge regarding the fall in inflation rate. We find that the monetary policy easing has been stronger in targeting countries, certainly thanks the initially higher policy rate among inflation targeters. Also thanks to monetary policy credibility, this translated into a lower increase in the real interest rate in countries that implement the inflation targeting strategy. However, in spite of those relatively good achievements regarding the monetary policy-making and the better initial macroeconomic conditions in targeting countries, the decline in the overall economic activity does not show any difference between targeters and non-targeters. In other words, considering the economic performances at large, inflation targeting did not make any difference in mitigating the effects of the 2008/2009 financial shock.

The remainder of the chapter is organized as follow: in section II, we aim at providing a broad presentation of the inflation targeting regime, including a definition of this policy strategy, some theoretical aspects of the framework and some features related to its implementation. Section III discusses the main arguments suggesting that inflation targeting countries can be expected to do better during the crisis. It explores the main features that can favor targeting countries regarding the changes in economic growth, inflation and interest rates performances. Section IV presents our analytical framework (the methodological approach and the sample selection). Section V provides and discusses the econometric results. Section VI is devoted to robustness checks. And section VII concludes.

II. The inflation targeting framework

II.1. Definition

As policy framework, inflation targeting is characterized by clear and explicit acknowledgement from the monetary authority that medium-to-long-run inflation stabilization is the primary goal. In this respect, an official and numerical inflation target (or a target range) is announced over one or more time horizons, defining the central bank objective. More broadly, Mishkin (2000) provides a definition of inflation targeting that relies on five main elements: (i) the public announcement of a medium-term numerical target for inflation; (ii) an institutional commitment for price stability as a primary goal of monetary policy, to which other goals are subordinated; (iii) an informative inclusive strategy in which many variables, and not only monetary aggregates or the exchange rate are used for deciding the setting of policy instruments; (iv) increased transparency of monetary policy through communication with the public and the markets about the plans, objectives, and decisions of the monetary authorities; and (v) increased accountability of the central bank for attaining objectives.

According to Bernanke et al. (1999), this focus on price stabilization in the monetary policy-making lies on three main arguments. The first argument has to do with the ability of monetary policy to control some specific macroeconomic variables (what monetary policy can and cannot do). Especially, the spread of the adoption of inflation targeting strategy and the emphasis on inflation stability reflects an increasing consensus among policymakers on the fact that monetary policy is more effective in controlling the aggregate price level than it might be in dealing with other concerns such as unemployment and the related problems. The second argument highlights the advantages of low and stable inflation. High inflation is detrimental for the economic environment since it may favor an overexpansion of the financial system, increase the vulnerability to financial crises, impair the functioning of the product and labor markets, generate additional costs related to frequent re-pricing and monitoring, and increase social disequilibrium through its distributional effects. Finally, the third argument is that inflation target provides the monetary authority with a nominal anchor. This puts forward the monetary authority commitment on its long term objective (even if deviations from this goal may arise in the short run) allowing a better anchorage of the private sector's expectations.

II.2. Modeling inflation targeting

Since its inception in the early 1990s, a large amount of researches have been conducted both empirically and theoretically on the inflation targeting strategy. Modeling inflation targeting remains an important issue in these works (issue relevant for any other monetary policy strategy, since models are generally very simple descriptions of the real world). We discuss two main features regarding the theoretical modeling of inflation targeting: the central bank's loss function and the reaction function which guides the policy instrument setting.

The central bank's loss function

Regarding the central bank loss function, the main question is whether the monetary authority is exclusively concerned with inflation stabilization or it also cares about other macroeconomic purposes such as output or employment. An early (but certainly restrictive) view of the inflation targeting strategy considers inflation stability as the sole targeting central banks objective. The policy instrument is set to stabilize inflation around the target without being (at least explicitly) concerned with other economic issues. Mervin King qualified central bankers conducting such a restrictive monetary policy strategy as "inflation nutters" (King, 1997). However, it is now widely agreed among academics and practitioners that the implementation of inflation targeting is actually not narrowed on controlling the changes in aggregated price levels, as targeters also put some weight on stabilizing the real activity. Monetary policy then has a broader role which is to control and reduce inflation deviations from the target, but also to stabilize the output gap.

Formally, the central bank's intertemporal loss function in period *t* can be described by the following equation:

$$L_t = (1-\delta)E_t \sum_{\tau=0}^{\infty} \delta^{\tau} \left[(\pi_{t+\tau} - \pi^*)^2 + \lambda y_{t+\tau}^2 \right] \qquad (1)$$

Where π_t and y_t denote the inflation and output gap at period t respectively. π^* is the inflation target, δ is the discount factor ($0 < \delta < 1$), and E_t denotes the expectation operator conditional to information available at period t. λ is the relative weight that is attached to the output gap stabilization.

Given the central bank commitment for inflation (and output gap) stability over the long run, the discount factor δ is likely to be very close to one, suggesting a constant valuation of this objective by the monetary authority over its mandate. For a discount factor close to one, the intertemporal loss function can be rewritten as the weighted sum of the unconditional variances of inflation and output gap.

$$L_t = \mathrm{var}(\pi_t) + \lambda\,\mathrm{var}(y_t) \qquad (2)$$

This is the most standard representation of the loss function found in the literature. To stabilize inflation around the target and the output around its potential level, in equation (2) the unconditional mean of inflation and output gap should be equal to the inflation target and zero, respectively. A zero target for the output gap suggests an output corresponding to the potential. In the inflation targeting framework, it is admitted that central banks should not have an overambitious objective in terms of output (monetary policy should not target an output exceeding the potential). This is to keep inflation as the main policy objective and to avoid any inflation bias. As discussed in Svensson (1999a), the inflation targeting strategy is consistent with the natural-rate hypothesis which advocates that the monetary policy cannot have a systematic effect on the average unemployment or the economy's capacity utilization. As a consequence, the monetary authority commitment to inflation stabilization ensures that any concern with the real activity is consistent with this natural-rate hypothesis, therefore eliminating the inflation bias which may arise through the output level target.

In such a framework, there is an asymmetry between inflation and output because the inflation target is subject to the authorities' (central bank and/or government) choice, while the output gap target is not. In the terms of Svensson (1999a), equation (2) where λ is equal to zero is considered to describe the "strict" inflation targeting, while λ positive and different from zero describes the "flexible" inflation targeting. Svensson (1997a) shows that implementing the flexible inflation targeting strategy has as a consequence some gradualism in the policy adjustments when inflation deviates from the target. This may require a longer horizon to meet the inflation objective.

The central bank's reaction function

Regarding the central bank's reaction function, the purpose is to set up a rule or to lay down the conditions which will guide the monetary authority's decisions on the policy instrument to achieve its target and minimize the loss function. Here we discuss two alternative formulations of the reaction function: an instrument rule and a targeting rule.

The commitment to an instrument rule involves a simple framework in which the central bank set the policy instrument (the short term interest rate) mechanically, following a relation (assumed to be stable over time) describing the policy rate as a function of small subset of variables capturing the information available at that time. The most common formulation of such a rule found in the literature is undoubtedly Taylor (1993) type rules that can be specified as follows:

$$i_t = \beta_i i_{t-1} + (1-\beta_i)[\beta_\pi(\pi_t - \pi^*) + \beta_y y_t] \tag{3}$$

where the βs are the response coefficients, expected to be positive. Following this reaction function, the central bank is expected to tighten the policy stance (increase the short term rate) when inflation is above the target, and when the output exceeds its potential level. The lagged short term interest rate is introduced to capture the smoothing behavior of the policy setting (in the sense that the monetary authority is also willing to avoid important short term rate volatility). The smoothing parameter is generally expected to be lower than 1.

Svensson (2002) points some advantages and disadvantages of an instrument rule. The first advantage is related to the simplicity of the rule that can then be easily verified by the private sector and other observers outside the central bank. Therefore, it would be technically feasible for the monetary authority to commit to such a rule. As second advantage, Taylor-type rules seem to be robust and perform quite well in simulations with different models, in terms minimization of the loss function. Regarding the disadvantages, Svensson (2002) first argues that the outcome of such a rule will not be optimal because it does not rely on a sufficiently large set of information and only imperfectly allows for history dependence. Second, it seems that inflation targeting central banks in practice follow a more elaborate process in their decision-making, relying on a larger subset of information and on conditional inflation and output forecasts. Third, central banks certainly deviate from this type of rules since empirical estimates suggest that they do not explain entirely the observed changes in the policy rate.

In light of the above disadvantages of instruments rules, Svensson (2002) suggests that the inflation targeting monetary policy strategy is better described by a commitment to a targeting rule. As for instrument rules, the purpose of targeting rule is to minimize a particular loss function. Especially, targeting rules can be expressed as a system of equations that the target variables must fulfil.[24] Consider for example a framework characterized by the standard new Keynesian model in which the central bank expectations on inflation and the output gap are affected by its "judgment".

$$\pi_{t+\tau,t} = \pi_{t+\tau+1,t} + \alpha_y y_{t+\tau,t} + \alpha_z z_{t+\tau,t} \tag{4}$$

$$y_{t+\tau,t} = y_{t+\tau+1,t} - \sigma_i (i_{t+\tau,t} - \pi_{t+\tau+1,t}) + \sigma_z z_{t+\tau,t} \tag{5}$$

Equations (4) and (5) describe the aggregate supply and demand respectively. z represents the central bank judgment on inflation and output gap expectations, and τ the forecast horizon assumed to be ≥ 1. In the framework characterized by equations (1), (4) and (5), Svensson (2002) shows that the optimal targeting rule corresponds to the standard efficient condition of equality between the marginal rates of substitution and the marginal rate of transformation between the target variables (the output gap and inflation). Let us assume a marginal increase in inflation two periods ahead only (*i.e.* $d\pi_{t+2,t} > 0$, and $d\pi_{t+j,t} = 0$ for $j \neq 2$). The aggregate supply equation suggests that this marginal increase in inflation requires a fall in the output gap one period ahead ($dy_{t+1,t} = -d\pi_{t+2,t}/\alpha_y < 0$), and an equal increase in the output gap two periods ahead ($dy_{t+2,t} = -dy_{t+1,t} > 0$). The marginal rate of transformation (MRT) of the linear combination $\tilde{y}_{t+1,t} \equiv (y_{t+1,t}, y_{t+2,t}) \equiv (1,-1) y_{t+1,t}$ into $\pi_{t+2,t}$ can be derived as:

[24] General forms of targeting rules are discussed in Svensson (1999, 2011). Here we expose a simple example of such a rule from Svensson (2002).

$$MRT(\pi_{t+2,t}, \tilde{y}_{t+1,t}) \equiv \left.\frac{d\pi_{t+2,t}}{dy_{t+1,t}}\right|_{dy_{t+2,t}=-dy_{t+1,t}} = -\alpha_y$$

And the marginal rate of substitution (MRS) of $\pi_{t+2,t}$ for the linear combination $\tilde{y}_{t+1,t}$ can be derived from the loss function (with the forecasts as arguments and considering the loss function's limit when δ approaches 1) as:

$$MRS(\pi_{t+2,t}, \tilde{y}_{t+1,t}) \equiv \left.\frac{d\pi_{t+2,t}}{dy_{t+1,t}}\right|_{dL_t=0, dy_{t+2,t}=-dy_{t+1,t}} = \frac{\lambda(y_{t+2,t} - y_{t+1,t})}{\pi_{t+2,t} + \pi^*}$$

Then, for all $\tau \geq 1$, applying the above derivations and setting the MRS equal to the MRT leads to the optimal specific targeting rule that can be specified as:

$$\pi_{t+\tau,t} - \pi^* = -\frac{\lambda}{\alpha_y}(y_{t+\tau,t} - y_{t+\tau-1,t}) \qquad (6)$$

Thus, in this particular example, the optimal targeting rule can be formulated as "find and instrument rate path so that the inflation gap forecast is $-\lambda/\alpha_y$ times the change in output gap". And the optimal "inflation forecast targeting" can be described as: (i) conditional to the judgment, find inflation and output gap forecasts that fulfil the targeting rule (6) and the aggregate supply relation (4); (ii) conditional to the judgment and these forecasts, find the instrument rate forecast that fulfils the aggregate demand equation (5); (iii) announce these forecasts and set the policy rate accordingly. Another example of targeting rule, based on a backward looking model is provided in Svensson (1997a). If applied by the monetary authority, it results in an endogenous optimal reaction function in which the policy instrument is set (taking into account all the relevant available information) so that the inflation forecast equals the inflation target.

According to Svensson (2002), targeting rules have the advantage to be easily verifiable with the published forecasts, as the rule is relatively simple. Since it only depends on the trade-off between the target variables, it should be relatively robust. The judgment does not directly affect the targeting rule and rather intervenes in the forecasts, making the rule independent from judgment. Such specific targeting rule however has the potential disadvantage to depend on a precise MRT. In this sense, it may not be robust to different specifications of the aggregate supply equation (for example, considering backward or forward looking specifications). Svensson (1997a, 2002) however argue that targeting rules perform better than instruments rules in describing the inflation targeting framework.

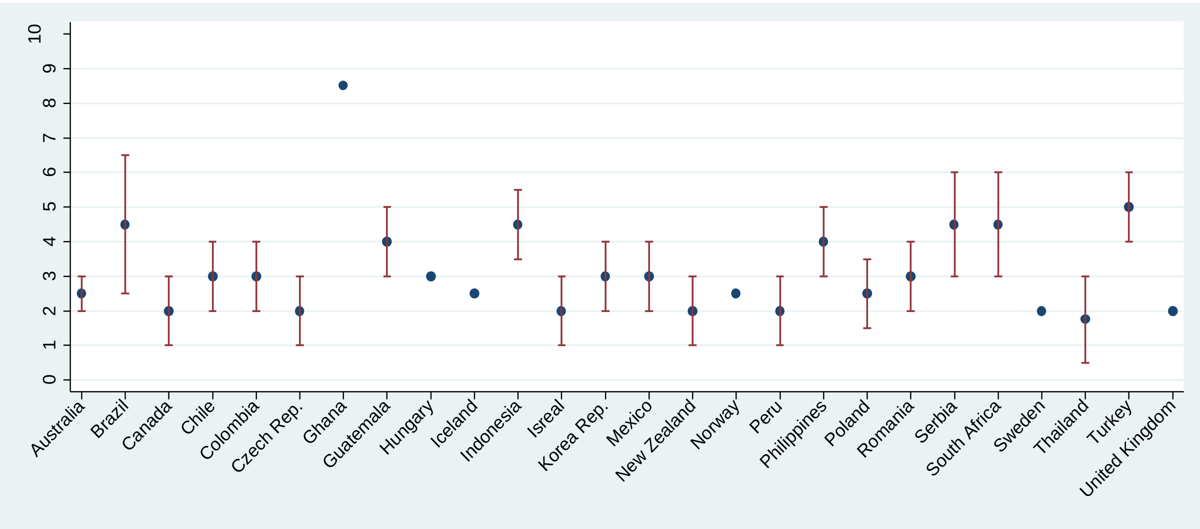
II.3. Inflation targeting in practice

In this subsection, we discuss some issues related to implementation of the inflation targeting strategy. The main practical points of the inflation targeting framework are discussed in a rather normative way, and we highlight some evolutions and differences observed among inflation targeters, based on countries experiences so far.

The implementation of inflation targeting poses some operational issues related for example to the measure of inflation that should be used. For transparency and flexibility, this measure should be familiar to the public and not include certain (extremely) volatile components of inflation. In this respect, most central banks use a CPI-based inflation, and focus on core inflation. Along the period in which the target is in effect, the chosen index should remain consistent to avoid any belief (from the private agents) that the target is being manipulated by the monetary authority. This may results in lower policy credibility. The experience so far shows that central banks have preferred inflation target rather than price-level target, certainly because the latter is likely to require periods of deflation with important costs in terms of output and employment.

Another issue is the definition of a numerical target (or target range). As argued by Alan Greenspan, the inflation target should be set so that, when making everyday decisions, it is not necessary for the private sector to take it into account. This suggests that the target should be sufficiently low so that inflation does not have a significant effect on the real economic activity. However, a zero (or a too low) inflation target is undesirable because, for example too low inflation may favor very low nominal interest rate, restricting the monetary policy ability to implement accommodative policies to boost the economy if needed (Blanchard et al., 2010; Ball, 2013). Another drawback for a (near) zero inflation target is that it can be associated with important deflationary risks that can impair the functioning of the financial system by causing significant liquidity and solvency problems. The level of the target varies considerably among inflation targeting central banks, particularly between high income countries on the one hand, and emerging and developing countries on the other. Recent experiences show that the inflation target (or the mid-point of the target range) is 2% or 2.5% for high income inflation targeters. In emerging and developing countries, target inflation rates are more heterogeneous and span from 2% in Czech Republic to 4.5% in Brazil or 5% in Turkey, for example (see figure II.1). To some extent, these differences in the target levels of inflation reflect a great heterogeneity in the macroeconomic conditions among emerging countries, but also in the perception of the central banks' ability to control the changes in aggregate price.

Figure II.1: Inflation targets and target ranges in 2012



Author, based on data from central banks

Setting an inflation objective to be achieved by the central bank poses the crucial and important question of the definition of the optimal inflation target. The appropriateness of the level of inflation to be targeted will require a good understanding of how a given inflation objective can affect the economic stability and the overall economic well-being. Best practice in the policy-making would involve central banks setting their inflation target at the level which maximizes the economic well-being of the public. Despites the common average 2%

inflation target which prevailed in most developed economies, rigorous estimates of the optimal inflation rate do not seemed so far to be available in the existing literature (Billi and Kahn, 2008). Schmitt-Grohé and Uribe (2011) investigate the extent to which these observed inflation targets set by most high income countries' central banks are consistent with the optimal rate of inflation, as predicted by the theory of monetary non-neutrality. Especially, their analysis is based on two main sources of the monetary non-neutrality, one relying on a nominal friction stemming from a demand for fiat money (the Freidman rule), and the other is based on the assumption of price stickiness. Their findings with various theoretical frameworks predict an optimal inflation target which is below the common 2% objective. Even taking into account the risk for the nominal interest rate to reach the zero lower bound, as in Coibion et al. (2012), these studies fail to predict the prevailing inflation targets. This highlights the difficulty to determine an optimal inflation objective to be pursuit by the monetary authority.

A large range of factors, related to the economic environment, but also potential measurement errors in the determination of the price index are to be taken into account when setting a numerical inflation objective. Furthermore, it may be argued that the optimal target level of inflation should differ from one country to another, and maybe especially between industrialized and emerging countries. This view is supported by the literature investigating the nonlinear relationship between inflation and economic growth, and suggesting that the threshold above which inflation impedes the economic activity is higher in developing countries, compared to their developed counterparts (see Kahn and Senadji, 2001, and Pollin and Zhu, 2006, among others). Another important issue regarding the optimal inflation objective has been raised in the aftermath of the 2008/2009 financial crisis. Indeed, the crisis seems to have questioned the relevance of the prevailing target levels, as it appeared that many central banks were more close to the zero lower bound interest rate than they thought. The costs associated with this zero lower bound constraint on monetary policy have shown to be very important. Therefore, there have been recent calls for an increase in inflation targets to prevent these costs in the future (see for example Krugman, 2014). However, further researches may be needed in this regard, since higher inflation objectives may bear some risks (Tabillini, 2014).

The target horizon is another relevant issue in the implementation of inflation targeting. For monetary policy to be effective, the horizon should not be too short since there is a time lag between the policy instrument setting and the expected effect on the target variable. Besides, the shorter the target horizon, the lower the monetary policy flexibility in terms of room available to deal with short term shocks or to support the real activity. However, if the target horizon is too large, this can impair the central bank credibility. It may be perceived as a monetary authority's inability to effectively control the aggregate price level. Note that the target horizon and the target rate can both change without necessarily affecting the central bank credibility. Especially for emerging countries, in the early period of the adoption of inflation targeting, the inflation target is relatively high and is progressively adjusted over time following improvements in the central banks performances.[25] Regarding the target horizon, it is also likely to vary during the transition period following the introduction of the inflation targeting regime. The monetary authority may also loosen the target horizon when faced with important macroeconomic shocks that can make it too costly to meet the inflation target in the medium term.

When the inflation target is set, the question of whether or not the monetary authority can (credibly) deviate from this target is of importance in the inflation targeting framework. Deviations from the announced objective can be necessary in the case of unforeseen events such as great enough supply shocks. In such circumstances, central bank should be able to clearly explain to the public why the target has been missed and what measures are to be undertaken in the future. Central bank commitment and accountability regarding the policy objective is also essential for a successful inflation targeting regime. The communication strategy of the monetary authority plays an important role in this regard. It should provide the public with timely and relevant information regarding its policy, its achievements, and the economy at large. In this respect, most inflation targeting central banks publish regularly (on a monthly or quarterly basis) an inflation report which provides such an overview of the monetary policy stance, the country's inflation performances and inflation expectations, and other relevant information for a better understanding of the monetary policy-making.

[25] The mid-point target in Brazil is 8% at the adoption date in 1999, and is now at 4.5%.

Regarding the type of rule that guides the policy rate setting, the recent literature suggests that inflation targeting central banks (at least among high income countries) mainly rely on expectations. The short term interest rate then responds to deviations of inflation forecasts from the target, and to the output gap forecasts. The response to forecast variables seems more reliable for the policy effectiveness since it takes account of the time lag between the interest rate setting and its effect on the target variables. The main purpose of the central bank policy is to anchor the private sector expectations. In the terms of Svensson, monetary policy follows an "inflation-forecast targeting rule". In emerging markets inflation targeters, the monetary policy-making is more ambiguous. Central banks have less experience in conducting an effective monetary policy and the macroeconomic models are certainly less performant, making forecasting exercises and expectations analyses less reliable. Consequently, it is less obvious that emerging markets inflation targeting central banks follow an inflation-forecast-targeting type rule. Besides, given their higher vulnerability to external shocks, the exchange rate variability remains a major concern. While the adoption of inflation targeting should be associated with a freely floating exchange rate regime, evidence suggests that emerging markets inflation targeting central banks intervene regularly on the foreign exchange markets.[26]

Some institutional prerequisites also characterized a successful inflation targeting regime. The most important is certainly the central bank independence, and particularly the instrument independence. The instrument independence requires that the central bank is solely responsible for setting the policy instrument to achieve the announced target. In such a framework, the monetary policy objectives (and potentially the inflation target) are set by the government (possibly in consultation with the monetary authority) and the central bank is completely responsible of the policy execution. The purpose of the instrument independence is to insulate the monetary policy from the legislative power and avoid the potential short term manipulations which may arise from certain groups of interest. It is argued that an independent central bank succeeds better in meeting the policy objectives and the literature

[26] This issue is discussed in more details in chapter III and V.

suggests that countries with independent central banks are more likely to adopt the inflation targeting regime (see Lin and Ye, 2007, among others).[27]

Moreover, the central bank independence strengthens it accountability regarding the policy outcomes. In practice, the degree of independence varies considerably among inflation targeters, particularly between developing and high income countries. The accountability is also formalized differently among targeters. In the United Kingdom for example, the governor of the central bank regularly gives a speech before the parliament, and he is required to provide explanations and detailed strategy to be undertaken if the inflation target has been missed. In New Zealand, a formal agreement between the government and the monetary authority confers to the former the legal right to dismiss the governor of the central bank if the inflation target is breached.

This section provides a very broad overview of the inflation targeting framework. We left aside the more technical aspects (in terms of modeling) and the large literature on the macroeconomic performances of inflation targeting, since the purpose here is to provide the reader with very general understanding of what inflation targeting is. In more than twenty years of implementation, the performances of inflation targeting (relative to other strategies) in achieving stable macroeconomic conditions have been widely investigated in the literature. However, the extent to which inflation targeting can perform better in coping with global shocks has been subject to much less attention in this literature. In fact, the 2008/2009 global financial crisis provides the first real opportunity to assess this issue since the inception of inflation targeting in the early 19990s. The rest of the chapter is devoted to this empirical analysis.

III. Faced with the crisis, why targeters can be expected to outperform the others?

Before the empirical assessment of the comparative performances of the inflation targeting regime during the recent crisis, we discuss the main reasons why this policy strategy can be

[27] This is also evidenced in chapters III and V.

expected to provide a better outcome in mitigating the effects of such a global financial shock. This is the aim of this section.

The 2008/2009 financial crisis originated from the U.S. financial market and spread to the rest of the global economy due to the global financial integration. Although financial sectors have been primarily affected by the consequences of the crisis, the real economy has also suffered from this shock, mainly through the credit channel. At the global level, the real interest rate went up (from 6% on average in 2003/2007 to 12% in 2009), investment declined, unemployment increased and the GDP growth dropped (from 6% on average in 2007 to 4% in 2008, and turned negative 2009). Faced with a crisis with such effects, why inflation targeting countries can be expected to perform better than the others? Our argumentation relies on two strands of the literature: the literature on the macroeconomic performances of the inflation targeting regime and the more recent literature on the determinants of the economies' resilience to the global financial shock. The former literature highlights some differences between targeters and non-targeters, due to the implementation of inflation targeting. We refer to the latter literature to investigate how these differences can affect the countries' performances during the global financial crisis.[28]

The comparison between targeters and non-targeters relies mainly on a set of 3 indicators: the economic activity captured by the GDP growth, inflation rate and inflation volatility, and interest rates (real, nominal and central banks reference rates). Our analysis intends to hypothesize that inflation targeters are likely to register better performances regarding these indicators in crisis periods. In what follows, we briefly discuss successively some relevant arguments supporting this hypothesis.

III.1. GDP growth

The empirical literature on the effects of inflation targeting puts forward some structural macroeconomic differences that can favor inflation targeters when dealing with negative economic or financial shocks. These are mainly related to fiscal and external position.

[28] We follow the literature on the recent financial crisis which argues that the initial macroeconomic conditions are crucial in determining how countries have coped with the crisis. See for example Lane and Melesi-Ferretti (2011).

Regarding the fiscal stance, Minea and Tapsoba (2014) highlight three channels through which inflation targeting can improve fiscal discipline. The first is related to the requirement of no fiscal dominance for an effective and credible inflation targeting regime. The second argument stresses a possible "discipline-enhancing" effect of the adoption of inflation targeting on fiscal policy which may hold particularly in developing countries. And the third refers to the Olivera-Keynes-Tanzi effect.[29] In their empirical investigations on a large sample of developed and developing countries, Minea and Tapsoba (2014) find that inflation targeting improves fiscal discipline. Precisely, the propensity score matching estimates reveal that inflation targeting has a positive and significant effect on the cyclically-adjusted primary balance, mainly in developing countries. Lucotte (2012) investigates the consequences of the adoption of inflation targeting on fiscal discipline in developing countries, through tax collection. The main argument developed in Lucotte (2012) is that, by giving the central bank the clear objective of price stability, the inflation targeting regime will be associated with a reduction in government debt financing through seigniorage. As a consequence, the fiscal authority will be more inclined to improve its tax revenue to compensate for the loss of this source of funding. Its estimates, based on the propensity score matching approach show that on average, public revenues are higher for inflation targeting countries. The conclusions of Abo-Zaid and Tuzemen (2012) on a sample of developed countries are in line with the above two studies. Their cross-countries analysis based on the difference in difference approach evidences that the adoption of inflation targeting is associated with a more disciplined fiscal policy.

According to Abo-Zaid and Tuzemen (2012), Lucotte (2012), and Minea and Tapsoba (2014), inflation targeting has a positive effect on the fiscal stance. If inflation targeting is associated with higher fiscal discipline, targeters can be expected to enter the crisis with stronger fiscal positions and especially with lower public debt. This can make a difference in crisis periods as the recent empirical literature shows that during the 2008/2009 shock, the collapse in the GDP growth have been significantly higher in countries with higher government debt (especially short term external debt) in the pre-crisis period (see Blanchard et al., 2010;

[29] The Olivera-Keynes-Tanzi effect refers to a context in which high inflation tends to reduce the volume of tax collection and the real value of tax revenue collected by a government.

Tsangarides, 2012; de Carvalho Filho, 2011). More generally, it can be assumed that governments lacking fiscal space will face more significant constraints during the crisis, as they will be less able to undertake necessary fiscal stimulus, because of the already substantial debt service burden which makes it less easy to run up more debt. Buiter (2009) further notices that government credibility regarding its fiscal stimulus during a shock depends on the sustainability of its initial deficit. Since inflation targeting improves fiscal discipline, targeters are expected to have sounder fiscal policy in the pre-crisis period, and consequently more scope to implement necessary adjustments during the crisis. This may ultimately help mitigating the fall in GDP. Appendix figure II.1 shows that the total government debt and the short term external debt in percentage of GDP are lower on average for targeters.

As regards the external position, Rose (2007) analyses the implications of the adoption of inflation targeting in terms of exchange rate volatility, external reserves accumulation, sudden stops of capital flows and current account balance. Using a large sample of advanced and developing countries over the period 1990 – 2005, the results of the empirical tests suggest that inflation targeting tends to reduce the exchange rate volatility and the exposure to sudden stops of capital inflows. For external reserves and current account balance, it seems to be no significant difference between targeters and non-targeters. A similar analysis is conducted in Lin (2010), also on a sample consisting of both developed and developing countries. Using the propensity score matching method, his empirical investigation is based on the 1985 – 2005 period. The results are follows: for developing countries, inflation targeting reduces the exchange rate volatility and increases external reserves accumulations. Conversely, for developed countries, inflation targeting is associated with an increase in exchange rate volatility and less external reserves accumulation.

The conclusions of Lin (2010) and Rose (2007) that inflation targeting is associated with lower exchange rate volatility and higher external reserves accumulation (at least among developing countries), can be relevant for the countries' resilience to international shocks. As pointed by Calvo (2010), international reserves do play a role during crisis periods as we do not have a global lender of last resort. In normal time (with international markets efficiency), we do not worry about external reserves. But in a context of global economic downturn and credit crisis as a result of the 2008/2009 financial crisis, external reserves can play a key role since central banks have to deal with credit problems that go beyond the countries boundaries. Indeed, in a context of crisis, foreign exchange markets are less efficient, making it less easy to get foreign currency in return for national currency.[30] Reserves can also serve as guarantee and eases fund access on international markets, and potentially at a lower rate. In that case, reserves can be perceived as a positive sign of country's solvency. During periods of high economic instability, international exchange reserves can also play an important role in the sense that it may guarantee the maintenance (at least in the short run) of the most important imports, without which some production activities may be compromised. This, in turn, can help minimizing the deterioration of the overall economic activity. The relative stability of the exchange rate can be perceived as an indicator of domestic currency stability on foreign exchange markets. In this sense, stable currencies may be more prone to absorb negative shocks, making the corresponding economies more resilient to international crises. With this in mind, targeters are expected to enter the crisis with better external position and then to be more resilient, especially in terms of GDP growth, since these benefits may help containing output losses during the crisis. Appendix figure II.1 shows that on average, inflation targeters faced better external balance compared to non-targeters even if the latter seem to have higher external reserves.

In light of the previous arguments, it can be argued that inflation targeting countries are expected to be more resilient during the global financial crisis, especially in terms GDP growth. The first hypothesis to be tested in our empirical investigation is therefore the extent to which the fall in GDP growth during the crisis has been lower for inflation targeters.

III.2. Interest rates

Other dissimilarities between targeters and non-targeters, more directly related to the monetary policy-making are highlighted by the empirical literature. According to de Carvalho Filho (2010), on average interest rates should be higher in inflation targeting countries during the economic boom which preceded the crisis, because in those countries, monetary policy

[30] Calvo (2010) emphasizes this issue by noticing the fact that during the crisis, the European Central Bank got a currency swap arrangement with the Federal Reserve.

should be more responsive to increasing liquidity and inflation. Indeed, as pointed by Mishkin (2000), price stability is the primary monetary policy objective within the inflation targeting regime. The central bank commits to this goal and is accountable for its achievement. In this regard, inflation targeting central banks tend to react more strictly to inflation pressures and set their interest rates more aggressively. This assumption is empirically supported by Lee (2010). He shows that the target interest rates are significantly higher for inflation targeting central banks, using the Fed and European Central Bank as counterfactual. Moreover as shown in figure II.3, the real and nominal interest rates are significantly higher for targeters during the five year preceding the crisis.

Thanks to this higher interest rate in inflation targeting countries, domestic investors are less prompted to acquire high-yields but potentially riskier foreign assets (as domestic funds and investments are relatively well remunerated). This insulates or preserves the domestic financial system from negative external financial shocks.[31] Maybe more importantly, these initially higher interest rates can give more room for loosening monetary policy when necessary. We mentioned that one of the most striking characteristics of the 2008/2009 financial crisis was the rise in real interest rates (from about 6% on average at the global level in 2003/2007 to 12% in 2009). This has resulted in higher instability in the financial markets, more restricted access to funding, and a fall in the total investment (see figure II.3 and appendix figure II.1). With this rise in real rates, and given that the monetary authorities are willing to mitigate the impact on the financial sector and the real economy, central banks implemented accommodative policies by lowering their policy rate. The initially higher policy rates for inflation targeters provide those central banks with more room for monetary policy easing (cuts in interest rates) before reaching the zero lower bound constraint. In such conditions, all other things being equal, inflation targeters can be expected to perform better in containing the rise in real interest rate during the crisis.[32] Besides, the lower rise in the real

[31] This issue is also discussed in chapters I and III.

[32] Other factors than the central banks decisions could affect the real interest rate, namely inflation or risk premium. Our empirical analysis will control for these other factors.

interest rate in inflation targeting may have help mitigating the fall in the economic activity through the investment channel.

Based on these arguments, we will investigate whether during the crisis inflation targeting central banks indeed lower their interest rate by more than non-targeters. In addition, we will also assess the extent to which the rise in real interest rate has been lower for targeters during the crisis.

III.3. Inflation

Last but not the least, another striking difference stressed by the empirical literature on inflation targeting is related to central bank credibility and transparency regarding the monetary policy-making. Johnson (2002) investigates the effect of inflation targeting on inflation expectations. His empirical study on a sample of high income countries shows that inflation targeting reduces inflation expectations and the volatility of these expectations across forecasters. In another empirical work also focused on high income inflation targeters, Johnson (2003) shows that the announcement of an inflation target results in a significant reduction of inflation expectations. According to Levin et al. (2004), inflation expectations should be better anchored in inflation targeting countries because their central banks are less responsive to short term developments in the real sector. With a sample of developed and developing countries, Levin et al. (2004) show that inflation targeting succeeds in disconnecting the current inflation expectations from the past inflation realizations. This result seems particularly robust in advanced economies. In a more recent study, Crowe (2010) hypothesizes that by reducing the informational asymmetries between the private sector and the central bank, inflation targeting enhances the monetary policy transparency and reduces forecast errors. His empirical analysis on a sample of developed and emerging inflation targeters shows that forecast errors on inflation are significantly reduced after the adoption of this monetary policy strategy.

The above mentioned studies support the effectiveness of inflation targeting in enhancing central banks credibility and transparency. As crisis periods are generally characterized by increasingly uncertainties and market failures in the financial sector (moral hazard and adverse selection), it can be argued that stronger central bank credibility is likely to be associated with more effective central bank's interventions, with the desired impact on financial markets. Also thanks to their higher credibility, as suggested by de Carvalho Filho (2010), emerging countries central banks which have adopted inflation targeting have more room for monetary policy easing during the crisis, without compromising their inflation objective. In addition, as credibility is essential for central bank to effectively control the increase in aggregate price levels, it is also important in dealing with deflationary risks that can arise from a global crisis.[33] Overall, if inflation targeting central banks are more credible and more effective in anchoring inflation expectations, they can be expected to be more effective than their peers in dealing with challenges they faced during the crisis in terms of inflation and inflation volatility.[34]

Following this argumentation, the fall in inflation rate and the rise inflation volatility can be expected to be lower in targeting countries during the crisis. Our empirical investigations intend to shed light on this assumption.

It should be worth noting that central bank credibility will certainly also affect the changes in interest rates during the crisis since, as we emphasized, monetary policy credibility plays a major role on the financial markets' perception of central banks announcements and interventions. The higher the central bank credibility, the more the financial sector will be willing to follow its policy prescriptions and announcements.

All these arguments, mainly suggested by the literature, support the assumption that inflation targeters can outperform their non-targeting counterparts when faced with a shock like the recent financial crisis. In the next section formal empirical tests are conducted to cheek the relevance of this hypothesis.

[33] This view is supported by the former governor of the Canadian central bank, Mark Carney, cited in de Carvalho Filho (2010), p. 4.

[34] As pointed by Svensson (2011), in 2008 a study of IMF finds that inflation targeting emerging countries have been most successful in anchoring inflation expectations during the oil and food price shock of 2007. This finding is in line with our assumption that inflation targeters can perform better in terms of inflation rate and inflation volatility during the financial crisis.

IV. The analytical framework

The comparative achievements of targeting and non-targeting countries are assessed on two main points. First, we investigate the extent to which targeters have performed better regarding the monetary policy effectiveness during the crisis (in terms of inflation rate, inflation volatility, real and nominal interest rates). These indicators are more closely (although not exclusively) related the central banks' policy. Second, the two groups are confronted on the basis of more general macroeconomic conditions, relying on GDP growth performances.

IV.1. Methodology

The purpose of the empirical investigation is to estimate the effect of inflation targeting on changes in the main variables mentioned above. In the context of the 2008/2009 crisis, applying an event study approach seems to be appropriated and more adequate as it allows capturing the change in the state of those economic indicators in "normal time", characterized by the pre-crisis period, compared to the crisis period when the shock has emerged. More precisely, we apply the difference in difference approach to assess whether the inflation targeting regime has an impact on changes in countries achievements during the crisis, compared to the pre-crisis period. The related equation can be specified as:

$$\Delta Y_i = \alpha + \beta IT_i + \theta X_i + \varepsilon_i \tag{7}$$

where $\Delta Y = Y_{cr} - Y_{pre}$ is the change in the output variable, with *cr* indicating the crisis period and *pre* the pre-crisis period. *IT* is a dummy variable which takes the value of 1 if a given country is an inflation targeter and 0 otherwise. *X* is the vector of control variables, ε the error term, and *i* the country index. β and θ capture the effect of inflation targeting and the effects of the control variables on ΔY, respectively. These parameters are to be estimated. As pointed by Ball and Sheridan (2005), the β coefficient can be biased, especially if Y_{pre} is correlated to *IT*. The idea is the following: let us consider the real interest rate. As already highlighted in the previous section, the real interest rate is higher, on average, in targeting countries during the pre-crisis period because of this monetary policy strategy (figure II.3). So the change in real rate relative to the crisis period will tend to be lower for targeters and the coefficient β will produce a spurious effect (especially, it will tend to overvalued the performance of *IT* in containing the rise in the real interest rate during the crisis) since we do not control for these initial differences caused by the implementation of the inflation targeting regime. In order to overcome this possible bias, we follow the recommendation of Ball and Sheridan (2005)[35] and introduce Y_{pre} as a control variable in equation (7). Therefore, the final "generic" model to be estimated is the following:

$$\Delta Y_i = \alpha + \beta IT_i + \theta X_i + \varphi Y_{ipre} + \varepsilon \qquad (8)$$

In equation (8) the coefficient β measures the effect of inflation targeting on the change in *Y*, given some initial conditions on *Y*. To give another example, let *Y* represents the GDP growth. If β is positive and significant, this suggests that inflation targeters did better (in terms GDP growth performances) during the crisis than non-targeters with the same average GDP growth in the pre-crisis period. This specification then control for the initial heterogeneity between targeters and non-targeters, potentially related to the implementation of the inflation targeting strategy.

IV.2. Period and sample

We use annual data from 2003 to 2009. The pre-crisis period consists of the five years preceding the crisis (from 2003 to 2007), while the crisis period is 2009. As a starting point, we focus on the year 2009 because it captures the financial crisis when its negative effects appear to be the most remarkable. In 2009, figure II.2 exhibits the lowest inflation rate and highest inflation volatility; figure II.3 shows the highest level of real interest rate, and appendix figure II.1 a negative GDP growth. Alternatively, for robustness check, we will consider 2008/2009 as crisis period since according to some studies, the financial crisis started in September 2008 with the failure of Lehman Brothers.

Regarding the sample, we refer to Lin (2010) and Roger (2009) for the list of inflation targeters (30 countries). We drop those which abandoned the strategy (Spain and Finland, in

[35] See the appendix on methodology.

1999) and those which adopted the targeting regime during our analysis period, in other to avoid a potential selection bias (Indonesia, Romania, Slovakia[36] and Guatemala which adopted the inflation targeting in 2005; Turkey and Serbia in 2006; and Ghana in 2007).

For the control group, we applied a selection criterion in the spirit of Lin and Ye (2009) based on the GDP per capita and the countries' population size. In order to get some homogeneity between the targeting and non-targeting subsamples, we keep in the control group countries with the average GDP per capita at least as large as the poorest inflation targeter during the 2003/2007 period. We also drop from the control group countries with GDP per capita higher than the richest inflation targeter in the same period. In addition, we keep countries with the population size at least as large as the smallest inflation targeter at the beginning of our study period (2003). Keeping countries for which data on our main dependent variables (inflation rate, real interest rate and GDP growth) are available, the whole basic sample consists of 67 countries,[37] including 20 inflation targeters. Nevertheless, depending on data availability for control variables, the number of observations will slightly vary from one regression to another. To further overcome the possible strong heterogeneity in this sample, we introduce the regional dummies from the World Bank classification in all the regressions.[38]

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[36] Slovakia joined the Euro zone in 2009.

[37] Philippines is the targeter with the lowest average GDP per capita in 2003/2007, 1110.3 USD and Norway is the targeter with the highest GDP per capita in the same period, 40417.12 USD. So we drop from our control group countries with average GDP less than 1110 USD and countries with average GDP per capita higher than 40417 USD. Iceland is the targeter with the lowest population size in 2003, 289521. We drop countries with population size lower than 289500. Starting with a sample of 205 countries, we get 99 left when applying the GDP per capita and population size criteria. Dropping countries with unavailable data on GDP growth, real interest rate and inflation rate, we get 67 countries left. See the basic sample in appendix table 1.

[38] Although we are in cross section, it seems necessary to account for heterogeneity as countries included in our sample have not been affected by the crisis in the same magnitude. However, we cannot introduce the countries' specific fixed effects. We then rely on the regional dummies to control (although, not perfectly) for some of those specificities. We keep North America regional dummy as reference and introduce all the others in the estimates: East Asia and Pacific (EAP); Europe and Central Asia (ECA); Latin America and Caribbean (LAC); Middle East and North Africa (MENA); South Asia (SA); and South-Saharan Africa (SSA).

We now turn to the empirical tests. First, comparative performances of central banks are investigated by testing the two last hypotheses specified in section III. Second, the two groups are compared in more general terms by testing the first hypothesis.

V. Empirical tests and results

Faced with the global financial crisis, we start by assessing the extent which inflation targeting may have performed better in terms of control of inflation and interest rates. As suggested earlier, these variables can be more directly related to the effectiveness of the central banks' decisions, and in a sense, they may capture the central banks performances during this crisis. In the second stage of our empirical analysis, targeting and non-targeting countries are confronted in more general terms, on the basis of the changes in economic growth.

V.1. Testing the comparative performances of central banks

As stated, central banks' performances during the crisis are analyzed through changes in inflation rate, inflation volatility, real and nominal interest rates. The control of inflation is commonly considered as a central bank's objective and thereby, a monetary policy outcome. Note that during the crisis the concern was "deflation scare", as inflation rates fell considerably at the global level and in many countries over the world (at least, those affected by the financial crisis). Therefore, rather than assessing the ability of inflation targeting in lowering inflation by more than other monetary policy strategies (as it has been extensively investigated in the literature), the purpose here is whether inflation targeters have been less affected by the decrease in aggregate price levels during the crisis. In other words, did inflation targeting central banks perform better than their non-targeting counterparts in mitigating the fall in inflation rate? Another notable consequence of the crisis is the rise in inflation volatility due to rising uncertainties, not only in the financial markets, but in the real economic activity. In this latter case, we investigate whether inflation trageters have been more resilient to this increasing inflation instability. To some extent, the question is whether the better performances of the inflation targeting regime in stabilizing inflation (as shown in the existing literature) also hold in a context of global financial and economic instability.

Formally, to test these hypotheses, equation (8) is estimated with *Y* representing the inflation rate and inflation volatility respectively. Following our discussion so far, the *IT* dummy is expected to be positively correlated with the change in inflation rate (suggesting that the deflationary risks have been lower in targeting countries during the crisis). On the contrary, the *IT* dummy is expected to be negatively correlated with the change in inflation volatility (suggesting a lower increase in inflation volatility in targeting countries). Regarding the other factors that may affect the dependents variables (the vector *X*), the following variables are considered:

GDP growth: It is recognized that countries which grow faster tend to be subject to higher inflation pressure. We control for the GDP growth prevailing at the onset of the crisis (in 2007).

Generated on average over the pre-crisis period (2003 – 2007), we also include:

M2 aggregate (in percentage of GDP): It controls for the liquidity in the economy.[39]

Imports in percentage of GDP: Imported inflation can be a particularly important source of the change in domestic aggregate price level, especially in developing economies. The size of the imports of goods and services (as a share of GDP) allows capturing this potential source of inflation.

Foreign liabilities/foreign assets: This ratio is introduced to control for flows of international capitals, and aims at capturing their potential effect on inflation stability.[40]

Credit growth: This indicator is used to capture developments in the financial sector, as changes in credit in the economy are likely to affect the level and the volatility of inflation.

Nominal exchange rate is introduced to control for a potential effect of exchange rate on changes in the domestic aggregate price.

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[39] M3 is certainly a more complete measure of liquidity, but data on this variable are much less available especially for developing countries.

[40] Note that we use alternatively the Ka. Open index of Chinn and Ito (2008) to control for the degree of capital openness. This does not change our findings.

The exchange rate is expected to be positively correlated with the dependent variables (and particularly with the change in inflation rate), because exchange rate appreciation can lower the domestic inflation rate by lowering the cost of imports, then reducing imported inflation. This effect of the exchange rate on the aggregate price level can also favor lower inflation variability because, as pointed by Fisher (1982), lower inflation rate is usually associated with lower inflation volatility. The others variables (Credit growth, GDP growth, M2 aggregate, Imports to GDP, and the Foreign liabilities/Foreign assets ratio) can be expected to have a negative effect on the dependents variables, as an increase in these indicators may be associated with higher inflation rate and inflation volatility in the pre-crisis period, making the changes with the crisis period lower.

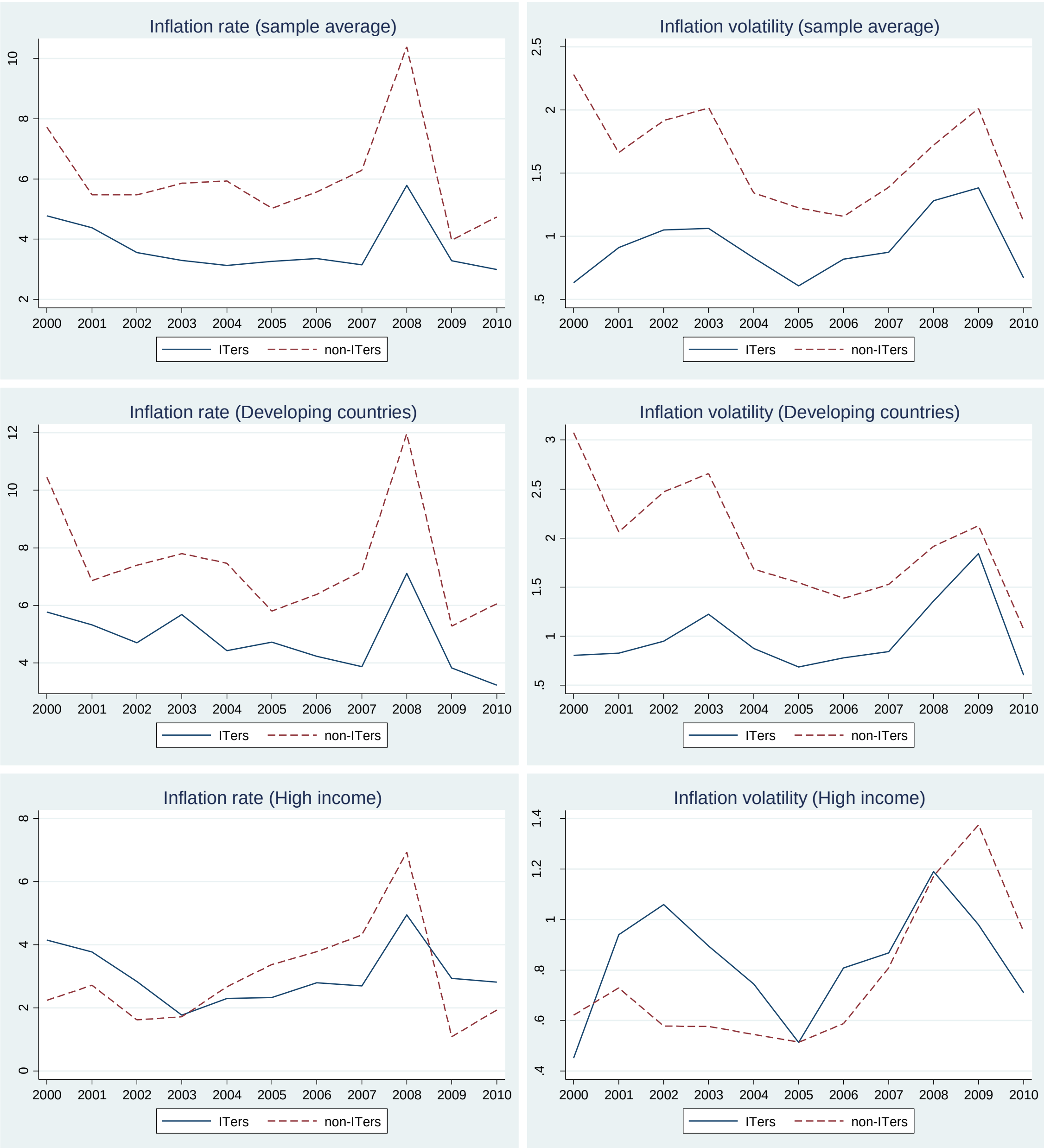
Figure II.2 exhibits the average inflation rate and inflation volatility for targeters and non-targeters over the period 2000 – 2010. It supports the empirical literature which suggests that the inflation targeting regime performs better than the other strategies in controlling both the level and the variability of inflation. This is more relevant among developing countries. The overall sample averages suggest that there is a little difference in terms of the level of inflation between the two groups during the crisis (in 2009). However, non-targeters seem to have faced higher increase in inflation volatility during this period, especially among high income countries.

Table II.1 provides the estimate results of the effect of inflation targeting on the changes inflation rate and inflation volatility. The findings suggest that there is no significant robust difference between targeters and non-targeters in terms of inflation rate. Only two of the five regressions exhibit a positive and significant effect of the *IT* dummy (columns 1 and 3). In short, it seems that the inflation targeting regime did not make a significant difference in mitigating the fall in inflation rate during the crisis. Conversely, the results presented in the second part of table II.1 suggest that the increase in inflation volatility during the crisis has been lower on average for targeters. The coefficient associated with the *IT* dummy is significant and negative for all the five regressions (columns 6 up to 10).[41] Non-inflation

[41] Inflation volatility is calculated as the standard deviation of monthly inflation rate. The smaller sample size for regressions on inflation volatility is due to limited availability of monthly inflation data for some countries in the sample.

targeting countries have been relatively more affected by the increase in inflation volatility during the crisis.

Figure II.2: Inflation rate and inflation volatility



Author's calculations based on data from International Financial Statistics (IFS)

Table II.1: Impact of inflation targeting on change in inflation rate and inflation volatility during the crisis

	Dependent variables									
	Change in inflation rate					Change in inflation volatility				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IT	1.277*	0.753	1.055*	1.139	1.205	-0.606*	-0.711**	-0.671**	-0.561*	-0.602*
	(1.831)	(0.971)	(1.854)	(1.499)	(1.583)	(-1.950)	(-2.219)	(-2.590)	(-1.803)	(-1.838)
GDP growth2007		-0.228*								
		(-1.898)								
Credit growth			0.0705*					0.0431***		
			(1.682)					(6.399)		
Imports (%GDP)				-0.00651						
				(-0.666)						
Exchange rate					2.36e-05		-0.000101			
					(0.0457)		(-1.007)			
M2 (%GDP)									-0.00713***	
									(-2.971)	
Foreign liabilities/assets										0.0158
										(1.419)
$Inflation_{pre}$	-0.215	-0.159	-0.317	-0.230	-0.228					
	(-0.790)	(-0.575)	(-1.123)	(-0.813)	(-0.674)					
$Inflation\ volatility_{pre}$						-0.990***	-1.003***	-1.028***	-1.014***	-0.970***
						(-31.37)	(-30.91)	(-28.74)	(-29.66)	(-27.09)
Constant	-2.660***	-2.068**	-2.733***	-2.391**	-2.590**	2.088***	2.142***	1.241***	2.617***	2.127***
	(-3.147)	(-2.336)	(-3.324)	(-2.433)	(-2.385)	(8.180)	(8.328)	(7.299)	(8.565)	(6.942)
Regional dummies included?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	67	67	63	66	64	54	52	51	53	51
Iters	20	20	20	20	20	17	17	17	17	17
Adjusted R-squared	0.0134	0.0876	0.170	0.00137	0.00768	0.880	0.884	0.931	0.885	0.884

Inflation volatility is generated each year as standard deviation of monthly inflation rate; robust t-statistics in parentheses; *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively.

Among the control variables, the coefficients associated with GDP growth, M2/GDP ratio and inflation volatility in the pre-crisis period are significant with the expected effect. Credit growth also shows a significant but positive coefficient.[42]

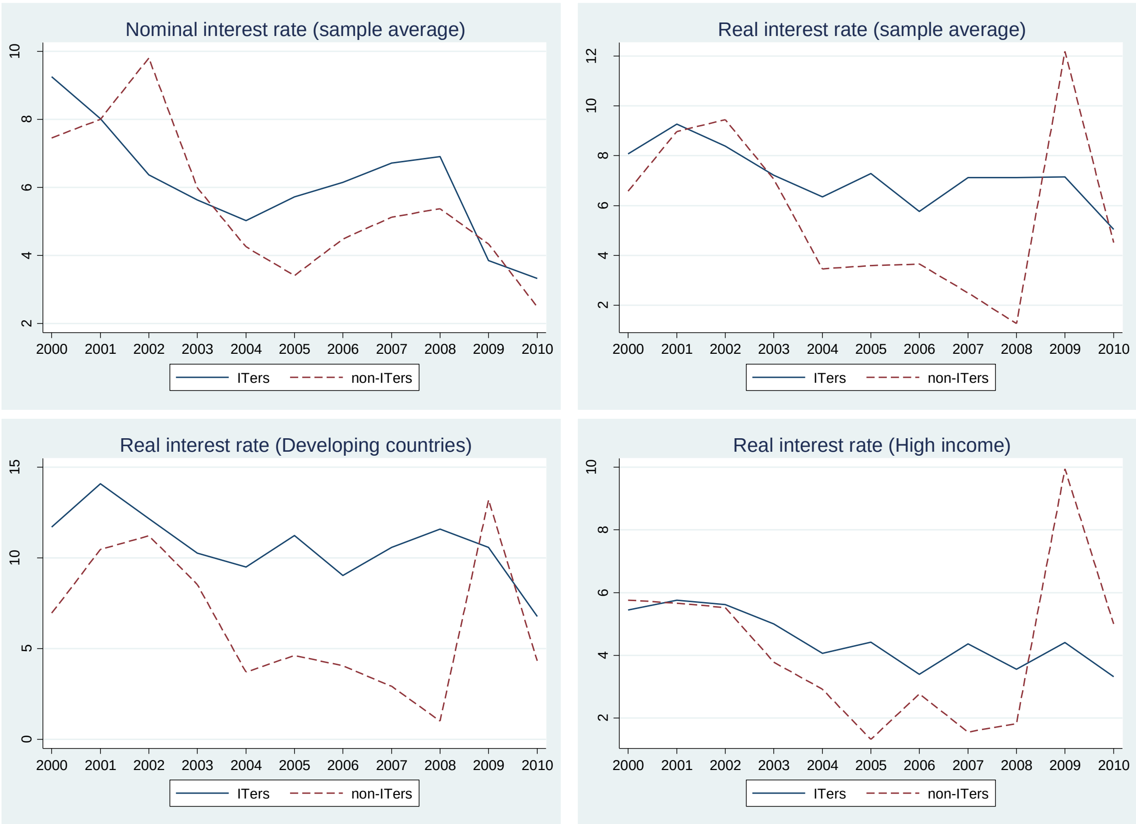
What about real and nominal interest rates? By focusing primarily on the real interest rate, we are interested above all on the extent to which central banks interventions (cuts in the policy rate and other measures undertaken to cope with the crisis) have effectively affected the cost of funding for borrowers (*i.e.* the lending real interest rate). This is of relevance because credit access is one the main determinant of investment which in turn determines the overall economic activity. Therefore, the lower the increase in the real interest rate, the lower the fall in investment which will translate into lower output losses. The change in the real interest rate is therefore the dependent variable that we are particularly interested in. However, the estimations results for nominal and central banks reference rates are also provided to clearly evidence that inflation targeting central banks had more room for monetary policy easing and indeed cut their policy rates by more than their non-targeting counterparts. Nominal interest rate is the “money market rate” and central banks reference rate the “central banks discount rate” (from IMF’s International Financial Statistics).

Figure II.3 shows the evolution of the average real and nominal interest rates for the two groups between 2000 and 2010. These summary descriptive statistics support our argumentation that on average, the interest rate is higher in inflation targeting countries, especially because of more aggressive responses to inflation pressures. Particularly, during the economic boom preceding the global financial crisis (2003 – 2007), the nominal interest rate appears to be on average 2 percentage points higher in targeting countries. This higher nominal interest rate coupled with lower inflation in targeting countries result in relatively higher real interest rate in those countries, compared to non-targeters. Figure II.3 also evidences that during the crisis period, the real interest rate increased sharply, especially in non-targeting countries. On the contrary, the nominal interest rate decreased, following the

[42] This ambiguity in the effect of credit growth may be justified by the fact that this indicator can actually capture various aspect of the financial sector such as financial instability or financial development. In the latter case, the more financial developed economies may be more effective in controlling the level of inflation in the pre-crisis period, making the change with the crisis period less pronounced. But at the same time, these countries may also be more affected by an international financial crisis (in terms inflation volatility), as they may be more connected with the international financial system.

monetary authorities interventions. In line with our intuition, the losening monetary policy (cuts in interest rates) seems to have been more significant in targeting countries. This certainly (at least partly) explains the lower rise in the real interest rate among inflation targeters.

Figure II.3: Nominal and real interest rates



Author’s calculations based on data from World Development Indicators & Global Developmemt Finance and IFS

For the purpose of the investigation of the effect of inflation targeting on the changes in interest rates, the estimated equation takes the form of equation (8), where the Y is the real, nominal, and central bank reference rates, successively. Regarding the control variables, for the change in real interest rate, the regressions include (generated on average over the pre-crisis period): *Banking credit* (as a share of GDP), a proxy for *Bank competition*, and the 2009 *inflation rate*. These controls are expected to be negatively correlated with the dependent variable. The increase in the 2009 inflation rate should be associated with lower real interest rate in the crisis period, and this will tend to lower the change in real interest rate with respect to the pre-crisis period. Financial development (proxied by the banking sector credit to GDP ratio) may have contributed to strengthen the resilience to the crisis, as the central banks' interventions should be better channeled through more developed financial sectors. In the same line of argument, bank competition may have favored the transmission of the central banks interventions, and contributed to mitigate the rise in interest rates in the banking sector. As discussed in section III, we also control for both *Inflation* and *Risk premium* on bank lending during the crisis in order to account for uncertainties in the financial markets.[43]

For regressions on nominal interest rates, the control variables encompass: the pre-crisis average values of *Bank competition*, *Broad money*, *Exchange rate*, and *Inflation rate* during the crisis. The last two variables are expected to be positively correlated with the dependent variable since an increase in inflation rate should be associated with higher nominal interest rate during the crisis period. Currency appreciation may lower the nominal interest rate in the pre-crisis period through lower inflation which can result from higher exchange rate. The other controls can be expected to be negatively correlated with the dependent variable, since bank competition and increasing market liquidity tend to increase the pre-crisis interest rate.

Finally, for regressions on central bank reference rates, control variables include: the crisis period *Inflation rate*, and the average values of *Broad money* and E*xchange rate* in the pre-crisis period. The first two variables are expected to be positively correlated to the central banks reference rate since the monetary policy stance will be tighten in response to higher inflation or increasing liquidity. Exchange rate can be expected to be negatively correlated with the reference rate since central banks would reduce the policy rate to cope with high domestic currency appreciation.

[43] Due to limited number of observations because of data availability on risk premium, these estimates are not included in table 2. Note however that we find the expected results. The risk premium increases the real interest rate while the coefficient associated with the IT dummy remains negative and significant.

Table II.2: Impact of inflation targeting on change in interest rates during the crisis

Dependent variables

	Change in real interest rate				Change in nominal interest rate				Change in central bank reference rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
IT	-5.554***	-4.660**	-5.351***	-4.078*	-0.883*	-1.217*	-1.353*	-1.005*	-1.791**	-1.797**	-2.389***
	(-2.864)	(-2.084)	(-2.799)	(-1.876)	(-1.698)	(-1.738)	(-1.790)	(-1.965)	(-2.605)	(-2.613)	(-3.643)
Bank competition	10.90*			4.701			0.200				
	(1.797)			(0.737)			(0.0773)				
Inflation2009			-0.168	-0.380	0.443***			0.275**	-0.0397		-0.158**
			(-0.646)	(-1.171)	(5.723)			(2.187)	(-0.375)		(-2.398)
Dom credit by BS		-0.0781**		-0.0866**							
		(-2.509)		(-2.463)							
Broad money (%GDP)						-0.0170**		-0.00514			-0.00678
						(-2.424)		(-0.714)			(-0.987)
Exchange rate								0.0008***		4.19e-05	1.92e-05
								(5.723)		(0.108)	(0.0525)
Real interest rate$_{pre}$	-0.757**	-0.694**	-0.770**	-0.781**							
	(-2.338)	(-2.417)	(-2.324)	(-2.110)							
Nominal interest rate$_{pre}$					-0.552***	-0.524***	-0.446***	-0.524***			
					(-7.974)	(-3.607)	(-3.000)	(-5.269)			
CB reference rate$_{pre}$									0.00812	-0.0160	-0.0251
									(0.124)	(-0.164)	(-0.282)
Constant	0.0569	19.57***	5.572	21.19**	0.723	3.489**	1.782	0.815	-2.343**	-2.257**	-2.648***
	(0.0125)	(3.105)	(1.665)	(2.510)	(1.295)	(2.563)	(0.791)	(0.741)	(-2.620)	(-2.412)	(-3.834)
Regional dummies included?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	64	65	67	64	40	35	38	35	45	45	41
Iters	19	20	20	19	16	16	16	16	19	19	19
Adjusted R-squared	0.300	0.368	0.274	0.391	0.571	0.470	0.326	0.651	0.118	0.114	0.224

Robust t-statistics in parentheses; *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively

Table II.2 provides the estimations results. The first part of this table gives the results for the regressions on the changes in real interest rate. The coefficient associated with the *IT* dummy is negative and strongly significant, suggesting that on average, the rise in real interest rates during the global financial crisis has been significantly lower for inflation targeting countries. The magnitude of the coefficient suggests that the difference in the changes in real interest rates between targeters and non-targeters is around 4.9 percentage points. Regarding the control variables, financial development appears to be the only statistically relevant determinant of the changes in real interest rate. The effect of credit to GDP is negative, in line with our assumption that the degree of financial development has contributed to enhance the resilience to the increase in the real rates, certainly through a better channeling of the central banks' interventions during the crisis.

The two other parts of table II.2 provide the estimates results for the changes in nominal and central banks reference rates. These results show that the changes in nominal interest and central banks reference rate have been more favorable in inflation targeting countries during the crisis.[44] Especially, the negative and significant effect of the *IT* dummy on changes in central banks reference rate suggests that cuts in the policy rate during the crisis have been more important for inflation targeting central banks, compared to their non-targeting counterparts. This finding is in line with our argumentation that inflation targeters have more room for monetary policy easing when needed. The higher cuts in policy rates by inflation targeting central banks have certainly contributed significantly to the lower rise in the real rates in those countries. The magnitude of the coefficients associated with *IT* is lower on average for the nominal rate estimates (compared to regressions on the real rate), certainly due to the sharp decreases in inflation during the crisis. As regard the control variables, the inflation rate is strongly significant with the expected effect. The exchange rate and liquidity also seem to be relevant, although with less robust effects.

To sum up, the findings regarding the central banks performances suggest that although inflation targeting did not make a significant difference in mitigating deflationary risks (the fall in inflation rate) during the crisis, targeters have performed better in controlling the

[44] Again, the changes in the size of the samples between the three parts of the table are due to data availability on our dependent variables. We also investigate the effect of IT on change in interest rates volatility and find no significant effect. The results have been discarded because of the low number of observations.

increase in inflation volatility during this period. More importantly, we show that inflation targeting countries have been relatively less affected than non-targeters by one of the most important consequences of the 2008/2009 global financial crisis, namely the rise in the real interest rates. The better performance in containing the rise in real interest rates can play an important for targeting economies, since by preserving credit access (or by limiting the rise in the cost of credit), it can also contribute to mitigate the fall in investment during the crisis, and ultimately improve the overall countries resilience to the shock. This effect, combined with the better initial conditions in terms of fiscal and external positions in targeting countries (as discussed in section III), can be expected to result in a lower fall of the economic activity in those countries, compared to non-targaters. The next subsection is precisely devoted to investigate the extent to which the overall economic activity has been less affected in targeting countries.

V.2. Testing the difference in GDP growth

Faced with the crisis, we now intend to compare targeting and on-targeting countries in a more general perspective. The purpose is to assess whether the economic downturn that has affected the global economy as a results of the financial crisis has been significantly less pronounced for inflation targeters. The discussion exposed in section III and the findings in the previous subsection provide some supportive arguments suggesting that inflation targeting can make a difference in context of such a global shock. To empirically investigate this issue, the estimated equation takes the form of equation (8) where Y is the GDP growth.[45] β is expected to be positive, suggesting on average, a smaller decline in the economic activity in targeting countries. The control variables include primarily those that seem to be the most relevant according to the recent literature on the 2008/2009 crisis (Blanchard et al., 2010; de Carvalho Filho, 2011; Lane and Milesi-Ferretti, 2011; and Tsangarides, 2012, among others). This first set of control variables (generated on average over the pre-crisis period) consists of:

[45] Note that we test the effect of inflation targeting on change in output volatility (approximated by industrial production volatility) and find no effect of the IT dummy. Due to limited data availability, these results have been discarded.

Trade openness: The more open economies are likely to be relatively more affected in case of adverse international shock.

The *Short-term external debt* (in percentage of GDP) captures the countries financial exposure, as pointed by Blanchard et al (2010). The larger the initial short-term debt, the stronger the country will be affected by the adverse shift in capital flows during the crisis, since larger current account deficit requires more capital flows.

Current account balance: Countries with large current account deficit will probably be more constraint in financing this deficit in crisis period.

Foreign exchange reserves (expressed in month of imports): As previously discussed, in period of international economic instability with global liquidity problems, the available foreign exchange reserves can play an important role, at least in the short term.

Within this first set of controls, the two last variables are expected to be positively correlated to the dependent variable, while the others negatively.

We also include the following two indicators capturing the financial and economic openness respectively: *Capital openness* and the *Economic globalization index*. These variables are expected to have a negative effect on the change in GDP growth, as the 2008/2009 financial crisis has been more detrimental for the more open economies, given their stronger connection to international financial markets and the related exposure to global shocks.

To account for developments in countries' financial sectors, we control for the banking sector *Credit growth* in the pre-crisis period. This variable captures to some extent the state of the initial financial conditions (in terms of financial fragility), and can be expected to be negatively correlated to the change in GDP growth.

GDP per capita (in the pre-crisis period) is used as indicator of countries' economic development. The more developed economies have been primarily affected by the global financial crisis, and to a larger extent, compared to developing countries (figure II.4). This proxy of the economic development is then expected to have a negative effect on the change in GDP growth.

The initial *Government budget balance* (as a share of GDP) is introduced to control for the fiscal stance, as government with higher deficit is likely to be more constraint in terms fiscal room available to cope with the crisis.

Finally and importantly, we control for the *Exchange rate regime*, a dummy variable taking the value of 1 if the regime is flexible and 0 otherwise. We follow Tsangarides (2012) and use countries de facto classification at end 2007 (to control for the exchange rate regime prevailing at the onset of the crisis). At least in theory, the adoption of inflation targeting should be associated with a freely floating exchange rate regime. However, countries with floating regime do not necessarily implement the inflation targeting strategy. Moreover, exchange rate regime could have made a difference in coping with the global financial crisis ("*Exchange rate flexibility, by easing adjustments, should be associated with smaller output losses in the face of external shocks*", Tsangarides, 2012, p. 470-471). To illustrate the adjustment property of the exchange rate flexibility, let us consider exports of goods. In case of negative demand shock (that may result from a global shock such as the 2008/2009 financial crisis) exporting economies may face a decline in output because of fall in exports. With the exchange rate flexibility, this negative demand shock will also lead to an exchange rate depreciation (following the fall in exports demand) which may improve price-competitiveness, leading ultimately to a second round favorable effect on exporting sectors. This second effect can offset, or at least mitigate the first one and result in smaller output losses. Given this (potential) role of exchange rate flexibility and the link between inflation targeting and exchange rate regime, it seems necessary to control for the exchange rate regime to make sure that the coefficient β captures the real effect of inflation targeting.[46]

Figure II.4 and appendix figure II.1 show that on average, GDP growth has been lower for targeters during the pre-crisis period. The GDP growth turns negative when the effects of the crisis culminate in 2009, for both developing and high income countries, although this fall in

[46] We do not hypothesize that the exchange rate regime is fully floating for all inflation targeters. Rather, we control for the de facto classification since some countries, and especially emerging inflation targeters are found to intervene on the foreign exchange market (see Aizenman et al., 2011). We precisely aim at controlling for a strictly flexible exchange rate regime to disentangle its potential effect to that of inflation targeting, and we do not wish to discuss the performances of exchange rate regime during the crisis. For more discussion on exchange rate regimes and the crisis, see Tsangarides (2012).

the economic activity seems to be significantly higher for the latter. The sample average does not exhibit a significant difference between the two groups during the crisis, but a more notable gap emerges in the high income countries subsample.

Figure II.4: GDP growth

Author's calculations based on data from World Development Indicators

Table II.3 provides the estimates results of the effect of inflation targeting on the change in GDP growth. In column (1) we run the basic regression with the *IT* dummy as the only independent variable (including the regional dummies). The finding from this baseline regression shows that inflation targeting has a positive and significant effect, suggesting that inflation targeters outperformed their peers in containing the fall in GDP growth during the crisis. As argued, this specification may capture a spurious effect of the inflation targeting regime. In a more rigorous approach, we need to control for the initial GDP growth and the exchange rate regime. Doing so, the coefficient associated to the *IT* dummy is no longer significant, suggesting that in fact, inflation targeting did not make any difference. The deterioration of the economic activity which occurs when the 2008/2009 financial crisis erupted, has not been statistically different between targeting and non-targeting countries. This finding is robust to all the six alternative specifications considered in the rest of table II.3 (columns 2 up to 7).

<u>Table II.3</u>: Impact of inflation targeting on changes in GDP growth during the crisis

	Dependent variable: change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	2.855**	0.307	0.773	1.251	1.206	-0.0108	-0.285
	(2.445)	(0.207)	(0.566)	(0.921)	(1.285)	(-0.00729)	(-0.193)
Credit growth			-0.110*				
			(-1.783)				
Economic globalization				-0.112***			
				(-2.815)			
Gov balance (%GDP)					0.147*		
					(1.861)		
Capital openness						-0.718*	
						(-1.849)	
Public debt (%GDP)							0.0229
							(1.178)
Current account balance							0.205*
							(1.899)
Trade openness							-0.0121
							(-1.382)
Exchange reserves							-0.202
							(-1.335)
GDP per capita							-0.000124*
							(-1.836)
Exchange rate regime		1.648	1.821	1.169	1.331	1.619	1.619
		(0.936)	(1.132)	(0.752)	(1.178)	(0.755)	(0.755)
GDP $growth_{pre}$		-0.608**	-0.397	-0.715*	-0.715*	-0.729*	-0.729*
		(-2.085)	(-1.302)	(-1.993)	(-1.783)	(-1.948)	(-1.948)
Constant	-6.656***	-5.399***	-5.679***	3.349	-4.909**	0.296	0.296
	(-5.975)	(-3.315)	(-3.507)	(1.095)	(-2.382)	(0.124)	(0.124)
Regional dummies	yes	yes	yes	yes	yes	yes	yes
Observations	67	65	62	62	50	52	60
Iters	20	20	20	20	20	20	20
Adjusted R-squared	0.191	0.380	0.440	0.438	0.423	0.401	0.366

Robust t-statistics in parentheses; *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively

With the exception of public debt, trade openness and foreign exchange reserves, all the control variables show a significant coefficient with the expected effect.[47] Negative and significant coefficients associated with economic globalization and capital openness indexes show that the more economically and financially open countries have been relatively more affected by the global financial crisis. Government budget balance and current account balance are found to have a positive effect on the change in GDP growth, suggesting that countries with stronger initial fiscal and current account positions have been more able to

[47] The short term external debt exhibits the significant and expected effect. The result is not reported in the table due to the low number of observations (38).

cope with the decline in the economic growth. Credit growth (a proxy for financial instability) negatively affects the dependent variable. This effect may be indicative of the fact that countries that entered the crisis with higher financial sector instability have also been more affected by the shock. Finally, the negative effect associated with the GDP per capita shows that the more developed economies have been relatively more affected by the crisis.

The GDP growth in the pre-crisis period seems to matter. Countries with initially higher GDP growth appear to have been more affected during the crisis. On the contrary, although positive, we do not find a significant effect for the exchange rate regime. A finding in line with the conclusions of Tsangarides (2012) who shows that the exchange rate regime did not make a difference regarding the countries' economic performances during the 2008/2009 financial shock. However, when the analysis is focused on the high income countries subsample, we find that the exchange rate regime does matter (appendix table II.6).

Is there a conditional or non-linear effect of inflation targeting?

The analysis conducted above on the direct effect of the inflation targeting regime on the economic performances during the crisis is unconclusive (no significant difference between targeting and non-targeting countries). However, it may be argued that the expected effect of inflation targeting might be conditional to some particular characteristics peculiar to targeting countries. In short, the effect of inflation targeting might be non-linear. To check this assumption, we investigate the extent to which, conditional to some macroeconomic characteristics, the implementation of the inflation targeting strategy has made a difference in mitigating the economic consequences of the global financial crisis. The following conditional variables are considered: economic globalization, debt, foreign exchange reserves and financial development. Countries that are the most integrated into the global economy, countries with higher initial level of debt, and countries with lower exchange reserves or less developed financial sector, have been relatively more affected by the crisis. The effect of inflation targeting may be potentially more significant if conditional to these initial characteristics.

In our empirical framework, we use the interactive variables approach to test these conditional effects. The *IT* dummy is interacted with each of the above mentioned variables. The results provided in the appendix table II.3 shows that none of those conditional effects is statistically significant. In line with the previous results, the coefficient associated to the *IT* dummy reveals that there is no effect of inflation targeting on the change in GDP growth.

Overall, our results reject the hypothesis that inflation targeters outperformed their peers in dealing with the output losses during the financial crisis. Although the existing literature on the comparative macroeconomic performances of the inflation targeting regime may suggest that targeters should be more resilient than non-targeters to international shocks, our empirical investigation does not seem to provide evidences supporting this intuition. Also, the significantly lower increase in real interest rates in targeting countries during the crisis does not seem to have made any difference between the two groups in terms of decline in total investment during this period (appendix figure II.1), highlighting the relevance of our findings regarding the overall economic performances.

V.3. Subsample analysis

Existing empirical researches on the relative performances of the inflation targeting regime emphasize the macroeconomic benefits of this monetary policy strategy, mostly among developing countries. It is then relevant to consider samples of developed and developing countries separately when assessing the effect of inflation targeting. Moreover, as suggested by descriptive statistics (figures II.1, II.2 and II.3) the consequences of the global financial crisis do not seem to have the same magnitude in high income and developing economies. In this subsection, we reassess the empirical issues discussed so far, but considering those two countries groups separately.

The World Bank classification is used to split our sample in 25 high income economies and 42 developing countries. Conducting the same empirical tests as above with these subsamples, we reach the same picture for the changes in GDP growth: inflation targeting did not make any difference (appendix table II.6). As regards inflation, there is no effect of inflation targeting on the change in inflation rate for the two subsamples, in line with the previous findings. Conversely, the *IT* dummy shows a significant and negative effect on the change in inflation volatility only for the high income countries subsample (appendix table II.4). This suggests that our conclusion with the whole sample is mostly driven by the effect of inflation targeting in developed countries. Although this result may seem to be at variance with the common conclusions in the literature suggesting that inflation targeting matters in developing but not in industrialized economies, our findings highlight the fact that high income countries are certainly more vulnerable to global financial shocks and the resulting economic instability. In such a context, it is likely that the benefits of the inflation targeting regime in terms stabilization and credibility appear to be more noticeable for this countries group.

Regarding the interest rates, we also reach the same conclusions for changes in real interest rates and central bank reference rates: in high income and developing countries, the rise in the real rate has been lower for targeters. Targeting central banks have also cut their policy rates to a larger extent compared to their non-targeting counterparts in the two subsamples. The difference in changes in nominal interest rates does not appear to be significant for neither of the two subsamples, suggesting that the effect of inflation targeting on the change in nominal interest rates during the crisis is not specific to any subsample but is rather more general (appendix table II.5).

To summarize, our empirical assessment suggests that while no significant difference emerges regarding the fall in inflation rate, inflation targeting central banks performed better than the others in managing the rise in inflation volatility that results from the high instability caused by the global financial crisis. This finding holds particularly for high income countries. The cut in the policy rates also seem to have been significantly more important for targeting central banks, compared to their non-targeting counterparts. Moreover, during this crisis, we evidence that inflation targeters did better in mitigating the increase in the real interest rates. However, in spite of these relatively good achievements in the monetary policy-making, when considering the economic performances in more general perspectives, it seems that the inflation targeting regime did not make any difference. Indeed, we find not significant effect of inflation targeting on the change in GDP growth, suggesting that the sharp fall in the economic activity during this crisis has been statistically equivalent in targeting and non-targeting countries.

VI. Robustness checks

Two main procedures are considered to check the robustness of the results discussed in the previous section: first, we define an alternative measure of the dependent variable, and second, we considered alternative control groups (non-targeting countries). Note that these robustness tests focus on the effect of inflation targeting on the change in GDP growth, which, in a sense, is of critical importance since it assesses whether the overall economic activity has been less affected in inflation targeting countries during the global financial crisis. This focus also aims to confront our findings to those of the only existing study (to the best of our knowledge) which investigates this issue by comparing targeters and non-targeters on the basis of change in GDP growth, namely de Carvalho Filho (2011). Results of robustness tests are provided in appendix table II.7.

Alternative measure of dependent variable

Considering 2008/2009 as the crisis period, the dependent variable is now the change in GDP growth between 2008/2009 and 2003/2007. Coefficients associated with the *IT* dummy are still not significant while for control variables, conclusions are almost the same as in our main analysis**.**

Alternative control groups

One of the main issues in the literature on the effect of inflation targeting is the definition of the control group. The conclusion regarding the role of inflation targeting is likely to be modified if the counterfactual changes. Therefore, using alternative control groups is undoubtedly one of the best strategies to check the robustness of our findings. Three cases are considered:[48]

[48] Because we need sufficiently large number of observations, only studies that use a sample of at least 50 countries have been chosen.

Rose (2007) and *Lin (2010) control groups*

Rose (2007) and Lin (2010) empirical analyses rely on samples of 68 and 74 countries respectively (including 23 inflation targeters in both cases). Running the same specifications as in our main regressions on the changes in GDP growth with the counterfactual of these two studies, our findings remain unchanged: inflation targeting did not make a difference in containing the decline in the economic activity during the crisis.

de Carvalho Filho (2011) control group

de Carvalho Filho (2011) compares the relative performances of targeters and non-targeters during the recent crisis. Using a sample of 51 countries including 23 targeters, he concludes that the latter did better since the fall in GDP growth has been significantly lower in targeting countries. Considering the same control group as in de Carvalho Filho (2011), we run our regressions' specifications and find that the *IT* dummy is still not significant. Note that our framework entails important differences which make it more rigorous. First, we follow Ball and Sheridan (2005) and control for the initial conditions (to deal with a potential bias in the estimated effect of inflation targeting) while de Carvalho Filho (2011) does not. Second, we control for the exchange rate regime to disentangle its potential effect from that of the inflation targeting regime in all our regressions, while de Carvalho Filho (2011) does not. It is worth noting that we find de Carvalho Filho's (2011) results when our regressions are considered without controlling for the exchange rate regime and initial GDP growth.[49] Third, in order to control for heterogeneity within the sample, we introduce the regional dummies. Finally, we use 2009 as the financial crisis period while de Carvalho Filho considered the 2008/2010 period.

VII. Conclusion

This chapter investigates the extent to which the inflation targeting regime has made a difference during recent financial crisis. The intuition relies on two main strands of the

[49] The *IT* dummy exhibits a significant and positive coefficient in almost all the estimates.

economic literature. First, the abundant literature on the macroeconomic performances of inflation targeting which suggests that the implementation of this monetary policy strategy is associated with important macroeconomic improvements. Especially, inflation targeting is found to be associated with lower and more stable inflation, higher fiscal discipline (including improvements in tax collection), higher foreign exchange reserves and more stable exchange rates (especially among emerging countries). Moreover, this literature emphasizes that the adoption of inflation targeting significantly increases central banks credibility, making targeting central banks more reliable regarding their policy objectives. Besides, given the main objective of inflation stabilization and the increase in the monetary authority accountability regarding this objective within the inflation targeting framework, targeting central banks respond more aggressively to inflation pressures through sharper increase in policy rates.

The second strand of the literature discussed in our argumentation is much more recent and emphasizes some important macroeconomic fundamentals that can improve the countries' resilience to the global financial crisis. This literature suggests that countries with initially sound fiscal policy (especially lower debt), higher foreign exchange reserves, good current account position, and relatively stable exchange rates have performed better in addressing this shock. Furthermore, we argue that thanks to their initially higher policy rates, inflation targeting central banks can be expected to loosen their monetary policy to a larger extent than non-targeters during the crisis. This in turn can significantly contribute to mitigate the decline in the economic activity through a lower increase in the cost of funding. The higher monetary policy credibility in targeting countries can also help containing deflationary risks, the increase in inflation volatility and the rise in real interest rates during this crisis.

The analysis relies on a sample of 67 developed and developing countries (including 20 inflation targeters), over the period 2003 to 2009 with annual data. The empirical tests are based on the difference in difference approach, in the spirit of Ball and Sheridan (2005). Our results suggest that targeting central banks (especially in developed countries) have significantly performed better in mitigating the rise in inflation volatility during the crisis, although no difference emerges regarding the fall in inflation rate. We also find that the monetary policy has been significantly more accommodative in targeting countries, certainly thanks to initially higher policy rates. This translated into a lower increase in the real interest rate (also thanks to monetary policy credibility) in countries which implemented the inflation targeting strategy. However, in spite of those relatively good achievements regarding the monetary policy-making and the better initial macroeconomic performances in targeting countries, the decline in the overall economic activity does not show any difference between targeters and non-targeters. In other words, considering the economic performances at large, inflation targeting did not make any difference in mitigating the effects of the 2008/2009 financial shock. The latter conclusion is somehow disappointing and may deserve further considerations. Why did targeters fail to perform better?

A first consideration that may seem to be relevant is about the magnitude of the 2008/2009 global financial crisis. A global crisis with such important effects is likely to affect the economies regardless the monetary policy regime in place. This argument can be supported by the analysis in Tsangarides (2012) on the role of exchange rate regimes. It is generally argued that exchange rate flexibility, by easing adjustments can serve as shock absorber and mitigate the effects of external shocks. Tsangarides (2012) investigates this issue in the context of the recent global financial crisis. Precisely, the paper assesses the extent to which the flexible exchange rate regime has been associated with smaller output losses during the crisis. The findings suggest that the exchange rate regime did not make a difference. The shock has been sizeable and indifferently affects the most developed and economically integrated economies. It is likely that our conclusions regarding the effect of the inflation targeting regime is consistent in this regard.

A second important consideration regards the characteristics of countries that have been the most particularly affected by the financial crisis. Originated from the U.S. financial market, the crisis spreads at the international level, mainly through strong interconnections between the most open economies. The results of our empirical assessment, in line with previous works on the 2008/2009 financial crisis, evidence that the most financially and economically integrated economies have been the most affected by the negative consequences of this crisis (table II.3). Interestingly, inflation targeting countries seem to be more integrated to the global economy compared to non-targeters. Indeed, statistical tests (T-tests) conducted for our particular sample on economic globalization (proxied by the KOF index) and capital openness (proxied by the Chinn and Ito index) reveal significant differences between targeters and non-targeters. This stronger integration into the global economy for targeting countries suggests higher vulnerability to international shocks. This, in fact, could have offset or at least mitigated the beneficial effect expected from inflation targeting.

The third consideration to be highlighted is about the monetary policy-making during the pre-crisis period. Some arguments suggest that by focusing mainly or exclusively on the inflation objective, inflation targeting central banks have been much less concerned with developments in the financial sector, and, to some extent, have contributed to increase the financial risk during the economic boom that preceded the crisis (Frankel, 2012 and CEPR, 2013 among others). Therefore, it is likely that failures (or shortcomings) in the financial regulation have been more sever in targeting countries. Frappa and Mésonnier (2010) investigate the extent to which the implementation of inflation targeting can be associated with higher financial instability. Their empirical analysis shows that the adoption of inflation targeting is associated with higher house price and price-to-rent ratio, suggesting higher financial fragility. A straightforward consequence of the potential less concern for financial instability in targeting countries is that the latter might have entered the crisis with a relatively more fragile financial sector. The results of the empirical investigation presented in table II.3 suggest that countries with higher initial financial instability (proxied by the credit growth) have been relatively more affected by the crisis.

In a sense, this possible higher financial fragility in targeting countries is a factor which has potentially impeded their ability to address the negative effects the crisis. Indeed, given the financial nature of this shock, the robustness of financial sectors and their ability to manage growing uncertainties and the period of high instability generated by the crisis is crucial in determining countries' overall economic performances during this period. As a main transmission mechanism for monetary policy, the financial sector plays a central role for the effectiveness of central banks interventions, and maybe particularly in period of high instability. In this regard, higher initial fragility in the financial sector for targeting countries might have weakened their performances in mitigating the output losses which resulted from the global crisis. This might have offset the positive effect (due to better initial macroeconomic conditions) expected from the inflation targeting regime. However, so far, the literature does not provide strong evidence that inflation targeting is associated with higher financial instability, especially among emerging countries (to the best of our knowledge, Frappa and Mésonnier, 2010 is the only existing related work focused on developed countries). The next chapter is particularly devoted to this issue in emerging market economies.

The analytical framework developed in this chapter, despites efforts to follow a rigorous approach, might not be free from some limitations. Especially, in light of the two arguments discussed above (related to the stronger economic and financial integration of inflation targeters into the global economy, and their higher financial fragility), it can be argued that the inflation targeting regime is not an exogenous variable in our empirical tests. However, our attempt to rely on a relatively homogenous sample of targeting and non-targeting countries, and to control for the initial conditions (prevailing before the crisis), might have mitigated this possible endogeneity of the inflation targeting strategy. Moreover, when assessing the effect of inflation targeting on the change in economic growth, we control for proxies capturing those differences in terms of economic and financial openness, and in terms of financial instability. While those approaches may only partially overcome a potential bias in the estimated effect of inflation targeting, the next chapter investigates those issues in a much more rigorous and appropriated framework, and the findings seems to be in line with our first intuition exposed at this stage.

Appendices

<u>Methodology:</u>

This technical appendix, derived from Ball and Sheridan (2005) briefly describes the intuition of equation (8) estimated in the empirical investigation of this chapter.

Assume that we would like to estimate the effect of inflation targeting on some economic performances (*Y*). As discussed in the main text, equation (7) can be biased, especially if the inflation targeting dummy is correlated with the pre-crisis level of *Y*. We argue that controlling for the pre-crisis level of *Y* however allows correcting this bias.

For simplicity, let us assume that for country *i*, the effect of inflation targeting on the change in *Y* is given by the following expression:

$$Y_{icr} - Y_{ipre} = (a_{cr} - a_{pre}) + \beta IT_i + (\varepsilon_{icr} - \varepsilon_{ipre}) \qquad \text{(A1)}$$

where, as in the main text, *cr* indicates the crisis period and *pre* the pre-crisis period. *a* is a time specific term and ε an error term. *IT* is a dummy variable which is equal to 1 for country *i* if the country is an inflation targeter and 0 otherwise. So the change in *Y* during the crisis is a function of a constant term $\alpha = (a_{cr} - a_{pre})$, the *IT* dummy and a composite error term $\varepsilon_i = (\varepsilon_{icr} - \varepsilon_{ipre})$. This specification corresponds to equation (7) in the text in which we argue that the effect of *IT* may be biased.

Suppose that due to the implementation of inflation targeting, some countries have significant higher Y_{pre} compared to non-targeters (in the text we take the example of interest rate which is higher in targeting countries). Since ε_{pre} is a component of Y_{pre}, this implies that the *IT* dummy is positively correlated with ε_{pre}. The composite error term encompasses $-\varepsilon_{pre}$, suggesting that the effect of *IT* is negatively correlated with the error term in equation (7) in the text. In short, this suggests that in OLS regressions, lower ε (which may be associated to higher Y_{pre}) will lead to an overestimation of the effect of *IT* on the change *Y*.

Let us consider the specification in which we control for Y_{pre} on the right hand side of our equation:

$$Y_{icr} - Y_{ipre} = (a_{cr} - a_{pre}) + \beta IT_i + \varphi Y_{ipre} + (\varepsilon_{icr} - \varepsilon_{ipre}) \qquad \text{(A2)}$$

where the true value of φ is zero if the initial conditions do not matter. Equation (A2) corresponds to the estimated equation (8) in the text. Intuitively, as discussed with the specification (A1), the bias in the effect of inflation targeting is due to the correlation between ε_{pre} and *IT*. But this correlation works through Y_{pre}. Accordingly, controlling for Y_{pre} in this auxiliary equation removes this relation between the error term and IT_i, making the estimated effect of *IT* more reliable.

Appendix table II.1: Basic sample

Non-iters			Iters
Albania	**Italy**	**Slovenia**	**Australia** (1993)
Algeria	Jamaica	Swaziland	Brazil (1999)
Argentina	Japan	Syrian Arab Republic	**Canada** (1991)
Armenia	Jordan	**Trinidad and Tobago**	Chile (1999)
Azerbaijan	Kosovo	**United States**	Colombia (1999)
Belarus	Latvia	Uruguay	Czech Republic (1997)
Bosnia and Herzegovina	Libya	Venezuela, RB	**Hungary** (2001)
Botswana	Lithuania		**Iceland** (2001)
Bulgaria	**Macao SAR, China**		**Israel** (1997)
Cape Verde	Macedonia, FYR		**Korea, Rep.** (2001)
China	Malaysia		Mexico (2001)
Costa Rica	**Malta**		New Zealand (1990)
Croatia	Mauritius		Norway (2001)
Dominican Republic	Namibia		Peru (2002)
Egypt, Arab Rep.	**Netherlands**		Philippines (2002)
Estonia	Panama		**Poland** (1998)
Fiji	Paraguay		South Africa (2000)
Honduras	**Qatar**		**Switzerland** (2000)
Hong Kong SAR, China	Russian Federation		Thailand (2000)
Iran, Islamic Rep.	**Singapore**		**United Kingdom** (1992)

Inflation targeting adoption date in parenthesis (Roger, 2009); High income countries in bold (World Bank classification)

Appendix table II.2: Data and sources

Variables	Definition	Sources
Inflation rate	Annual change in consumer price index (%)	WDI & GDF
GDP growth	Annual percentage growth rate of GDP at market prices based on constant local currency	WDI & GDF
GDP per capita	GDP per capita (constant, in USD)	WDI & GDI
Exchange reserves	Total reserves in months of imports	WDI & GDI
Dom credit by BS	Domestic credit provided by banking sector (in % of GDP)	WDI & GDF
M2 (% GDP)	Money and quasi money (M2, in % of GDP)	WDI & GDF
Imports (% GDP)	Imports of goods and services (in % GDP)	WDI & GDF
Risk premium	Interest rate charged by banks on loans to prime private sector customers minus the "risk free" treasury bill interest rate	WDI & GDF
Real interest rate	Lending interest rate adjusted for inflation as measured by the GDP deflator	WDI & GDF
Capital openness	Chinn and Ito financial openness index	Chinn and Ito (2008, updated 2009)
Trade openness	Sum of exports and imports of goods and services (in % of GDP)	WDI & GDF
Short term debt	Debt that has an original maturity of one year or less (in % of GDP)	WDI & GDF
Government balance	Government cash surplus/deficit (in % of GDP)	WDI & GDF
Current account balance	Measure the current account (in % of GDP)	WDI & GDF
Foreign liabilities/assets	Ratio of foreign liabilities to foreign assets	IFS
Inflation volatility	Standard deviation of monthly inflation rate for each year	IFS
Broad money	Broad money expressed in % GDP	IFS
Exchange rate	Nominal exchange rate (US dollar per national currency)	IFS
Nominal interest rate	Money market rate	IFS
CB reference rate	Central bank discount rate	IFS
Credit growth	Growth in claims of banking system on private sector	IFS
Exchange regime	Dummy variable, = 1 if the exchange rate regime is flexible and 0 otherwise	de facto classification in Ghosh et al (2011)
Bank competition	Bank concentration	Beck et al (2009)
Economic globalization	Measure of countries economic globalization (KOF index)	Dreher (2006, updated 2011)

WDI & GDF (World Development Indicators and Global Development Finance), IFS (International Financial Statistics)

<u>Appendix table II.3</u>: Assessing the conditional effect of inflation targeting on change in GDP growth

	Dependent variable: change in GDP growth				
	(1)	(2)	(3)	(4)	(5)
IT	0.307 (0.207)	-10.30 (-1.351)	2.287 (1.174)	3.068 (1.201)	1.245 (0.520)
IT*Economic globalization		0.181 (1.667)			
IT*Financial development			-0.00591 (-0.295)		
IT*Public debt				-0.0257 (-0.661)	
IT*Exchange reserves					0.108 (0.286)
Economic globalization		-0.179*** (-3.201)	-0.141*** (-3.501)	-0.140*** (-3.504)	-0.139*** (-3.267)
Financial development		-0.000709 (-0.0518)	0.00456 (0.239)	0.000176 (0.0103)	0.00247 (0.163)
Public debt		0.0230 (1.009)	0.0189 (0.802)	0.0260 (0.917)	0.0204 (0.930)
Exchange reserves		-0.180 (-1.015)	-0.228 (-1.345)	-0.218 (-1.261)	-0.230 (-1.276)
Exchange rate regime	1.648 (0.936)	0.00694 (0.00333)	0.757 (0.447)	0.655 (0.401)	0.812 (0.485)
GDP $growth_{pre}$	-0.608** (-2.085)	-0.611*** (-2.975)	-0.630* (-1.751)	-0.626* (-1.739)	-0.635* (-1.764)
Constant	-5.399*** (-3.315)	8.391* (1.831)	3.822 (1.027)	4.184 (1.141)	3.869 (1.056)
Regional dummies	yes	yes	yes	yes	yes
Observations	65	60	60	60	60
Adjusted R-squared	0.380	0.449	0.409	0.410	0.408

Robust t-statistics in parentheses, *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively.

Appendix table II.4: Effect of inflation targeting on changes in inflation (Subsamples analysis)

	Developing countries									
	Change in inflation rate					Change in inflation volatility				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IT	0.352	0.0368	0.518	-0.919	0.245	-0.406	-0.396	-0.269	-0.411	-0.351
	(0.396)	(0.0410)	(0.574)	(-0.946)	(0.261)	(-1.096)	(-1.040)	(-0.681)	(-1.136)	(-0.985)
$Inflation_{pre}$	-0.174	-0.155	-0.195	-0.269	-0.185					
	(-0.579)	(-0.510)	(-0.633)	(-0.867)	(-0.509)					
$Inflation\ volatility_{pre}$						-1.029***	-1.026***	-1.025***	-1.016***	-0.998***
						(-23.97)	(-24.85)	(-23.14)	(-24.92)	(-23.05)
Constant	-0.430	1.085	-0.839	3.108	-0.250	2.303***	2.328***	1.911***	1.924***	2.289***
	(-0.272)	(0.667)	(-0.553)	(1.357)	(-0.137)	(8.972)	(8.987)	(6.166)	(5.230)	(8.972)
Observations	42	42	42	41	41	35	35	35	35	35
Adjusted R-squared	0.00127	0.0248	0.0156	0.0517	0.0221	0.929	0.928	0.936	0.930	0.936

	Developed countries									
	Change in inflation rate					Change in inflation volatility				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IT	2.003	1.469	1.196	2.261*	2.026	-0.724*	-0.793*	-1.084**	-0.795*	-0.804*
	(1.717)	(1.231)	(1.073)	(1.763)	(1.556)	(-1.928)	(-1.919)	(-2.827)	(-1.894)	(-2.014)
$Inflation_{pre}$	-0.826	-0.600	-1.268*	-0.774	-0.818					
	(-1.445)	(-1.335)	(-2.044)	(-1.320)	(-1.372)					
$Inflation\ volatility_{pre}$						-0.0147	-0.0206	-0.460	0.197	-0.0524
						(-0.0377)	(-0.0445)	(-0.924)	(0.359)	(-0.128)
Constant	0.253	0.842	0.182	-0.473	0.132	0.443	0.611	0.887**	-0.0556	0.525
	(0.221)	(0.680)	(0.186)	(-0.347)	(0.108)	(1.352)	(1.337)	(2.791)	(-0.0618)	(1.629)
Observations	25	25	25	25	23	19	17	19	18	16
Adjusted R-squared	0.252	0.282	0.446	0.227	0.208	0.0959	0.0660	0.386	0.0628	0.269

Control variables (not reported here) are the same as in table II.1, robust t-statistics in parentheses, *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively

Appendix table II.5: Effect of inflation targeting on changes in interest rates (Subsamples analysis)

Developing countries										
	Change in real interest rate			Change in nominal interest rate				Change in central bank reference rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IT	-4.508*	-1.795	-4.950*	-0.454	-0.874	-1.157	-0.422	-2.608***	-2.475***	-2.811***
	(-1.760)	(-0.574)	(-1.863)	(-0.672)	(-1.021)	(-1.187)	(-0.755)	(-3.226)	(-3.250)	(-3.001)
Real interest rate$_{pre}$	-0.722**	-0.677**	-0.744*							
	(-2.086)	(-2.358)	(-1.957)							
Nominal interest rate$_{pre}$				-0.564***	-0.523***	-0.481***	-0.553***			
				(-8.324)	(-4.121)	(-3.787)	(-9.489)			
CB reference rate$_{pre}$								0.000855	-0.0511	5.24e-05
								(0.0125)	(-0.559)	(0.000492)
Constant	8.287*	17.82***	13.18***	0.666	3.553**	3.540	-0.942	-0.515	-0.687	-0.514
	(1.859)	(3.692)	(2.720)	(0.816)	(2.824)	(1.603)	(-0.588)	(-1.124)	(-1.226)	(-0.521)
Observations	40	41	42	24	24	23	23	27	27	26
Adjusted R-squared	0.236	0.394	0.235	0.661	0.530	0.506	0.767	0.289	0.250	0.234

Developed countries										
	Change in real interest rate			Change in nominal interest rate				Change in central bank reference rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IT	-6.544*	-4.337*	-5.166**	-2.011	-2.319	-1.580	-1.958	-2.487*	-2.515*	-2.195*
	(-1.722)	(-1.744)	(-2.112)	(-1.733)	(-1.656)	(-1.327)	(-1.104)	(-1.986)	(-2.080)	(-1.971)
Real interest rate$_{pre}$		-2.139***	-3.133***							
		(-4.611)	(-3.975)							
Nominal interest rate$_{pre}$				-0.419	0.158	-0.362	-0.595*			
				(-1.695)	(0.361)	(-1.468)	(-2.056)			
CB reference rate$_{pre}$								0.0236	0.242	-0.286*
								(0.0848)	(1.062)	(-2.107)
Constant	6.300*	0.822	13.06***	0.805	0.257	-1.460	3.725	-0.331	-1.102	2.648
	(1.750)	(0.218)	(4.045)	(0.794)	(0.1000)	(-1.183)	(1.862)	(-0.288)	(-0.905)	(1.477)
Observations	25	24	25	16	14	15	12	18	18	15
Adjusted R-squared	0.0690	0.613	0.657	0.254	0.0231	0.145	0.237	0.160	0.159	0.270

Control variables (not reported here) are the same as in table II.2; robust t-statistics in parentheses; *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively

Appendix table II.6: Effect of inflation targeting on changes in GDP growth (Subsamples analysis)

	Developing countries						
	Change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	1.289	-0.245	-1.231	1.144	2.068	-0.745	-2.778
	(0.951)	(-0.177)	(-0.911)	(0.972)	(1.154)	(-0.494)	(-1.153)
Exchange regime		0.222	0.338	-0.0666	-0.702	-0.554	2.902
		(0.133)	(0.236)	(-0.0540)	(-0.457)	(-0.343)	(1.184)
GDP growth$_{pre}$		-0.902**	-0.457	-0.809*	-1.002	-0.900	-0.526
		(-2.057)	(-1.008)	(-2.022)	(-1.570)	(-1.338)	(-1.176)
Constant	-7.580***	-1.636	-0.241	10.66*	-2.119	-0.307	-1.010
	(-6.325)	(-0.661)	(-0.106)	(2.026)	(-0.543)	(-0.0866)	(-0.212)
Observations	42	41	41	40	28	33	37
Adjusted R-squared	0.007	0.230	0.487	0.382	0.291	0.206	0.369

	Developed countries						
	Change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	4.238**	0.640	2.364	1.542	-0.529	0.409	-1.129
	(2.485)	(0.549)	(1.561)	(0.801)	(-0.626)	(0.266)	(-0.670)
Exchange regime		3.014**	3.741*	1.903	3.860***	1.846	5.969**
		(2.240)	(1.996)	(1.099)	(4.139)	(1.146)	(2.146)
GDP growth$_{pre}$		-0.399	0.0355	-1.171**	-0.551	-1.188**	-1.887***
		(-0.911)	(0.0772)	(-2.520)	(-1.333)	(-2.469)	-0.172
Constant	-10.05***	-7.713***	-9.428**	-2.229	-6.844***	-2.141	(-0.0698)
	(-7.000)	(-3.581)	(-2.796)	(-0.310)	(-3.277)	(-1.104)	(-0.0301)
Observations	25	24	21	22	22	19	23
Adjusted R-squared	0.171	0.229	0.431	0.484	0.292	0.467	0.656

Control variables (not reported here) are the same as in table II.3; robust t-statistics in parentheses; *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively

Appendix table II.7: Robustness checks

	Alternative definition of the crisis period (2008/2009)						
	Change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	1.917**	0.167	0.553	0.939	1.097	0.0830	-0.242
	(2.200)	(0.137)	(0.512)	(0.803)	(1.282)	(0.0609)	(-0.187)
Exchange regime		1.126	1.250	0.564	0.574	0.383	1.226
		(0.799)	(0.995)	(0.460)	(0.642)	(0.260)	(0.746)
GDP $growth_{pre}$		-0.438**	-0.269	-0.625***	-0.527**	-0.801**	-0.679***
		(-2.417)	(-1.376)	(-3.151)	(-2.362)	(-2.466)	(-3.189)
Constant	-4.784***	-3.859***	-4.044***	4.199	-3.165**	0.533	1.540
	(-6.946)	(-3.293)	(-3.279)	(1.557)	(-2.392)	(0.320)	(0.921)
Observations	67	65	62	62	50	52	60
Adjusted R-squared	0.152	0.301	0.380	0.430	0.365	0.334	0.357

	Rose 2007 control group						
	Change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	3.032**	1.414	1.346	1.899	0.477	0.989	1.697
	(2.450)	(1.075)	(1.062)	(1.189)	(0.462)	(0.651)	(0.988)
Exchange regime		-1.079	-0.473	-0.943	0.471	-1.946	-1.720
		(-0.705)	(-0.323)	(-0.529)	(0.379)	(-1.129)	(-0.795)
GDP $growth_{pre}$		-1.094***	-0.714*	-1.152***	-1.468***	-1.398***	-1.052**
		(-2.821)	(-1.872)	(-3.129)	(-3.419)	(-3.069)	(-2.416)
Constant	-6.744***	-1.923	-2.919	4.503	-1.820	2.829	1.276
	(-5.636)	(-1.045)	(-1.585)	(1.157)	(-1.006)	(1.117)	(0.429)
Observations	58	57	53	55	48	46	54
Adjusted R-squared	0.315	0.464	0.492	0.462	0.533	0.535	0.425

Appendix table II.7: (continued)

Lin (2010) control group

	Change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	2.343**	1.233	1.387	1.559	0.259	0.813	1.564
	(2.135)	(0.868)	(1.016)	(0.926)	(0.258)	(0.512)	(0.908)
Exchange regime		-1.408	-0.451	-1.430	0.427	-2.297	-1.902
		(-0.876)	(-0.292)	(-0.764)	(0.359)	(-1.328)	(-0.866)
GDP $growth_{pre}$		-1.227***	-0.750*	-1.312***	-1.533***	-1.494***	-1.110***
		(-3.629)	(-1.996)	(-4.035)	(-4.308)	(-3.643)	(-3.013)
Constant	-6.400***	-1.146	-2.898	4.650	-1.577	3.471	1.826
	(-6.840)	(-0.712)	(-1.562)	(1.316)	(-1.041)	(1.516)	(0.686)
Observations	67	66	55	64	57	55	63
Adjusted R-squared	0.242	0.493	0.511	0.489	0.569	0.555	0.475

de Carvalho Filho (2011) control group

	Change in GDP growth						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT	2.209**	1.937	2.689**	1.873	0.738	0.384	3.110
	(2.225)	(1.344)	(2.136)	(1.240)	(0.628)	(0.273)	(1.678)
Exchange regime		-0.833	1.475	-0.951	1.370	0.227	-2.438
		(-0.526)	(0.924)	(-0.581)	(1.034)	(0.147)	(-1.184)
GDP $growth_{pre}$		-0.554	-0.0357	-0.577*	-1.237**	-0.326	-0.156
		(-1.404)	(-0.0680)	(-1.781)	(-2.328)	(-0.990)	(-0.380)
Constant	-4.191**	-0.890	-7.750**	-0.248	-3.639*	-2.488	-4.494
	(-2.110)	(-0.255)	(-2.601)	(-0.0498)	(-1.730)	(-0.914)	(-1.318)
Observations	47	47	33	46	40	39	47
Adjusted R-squared	0.107	0.163	0.212	0.143	0.477	0.0414	0.149

Note: Control variables (not reported here) are the same as in table II.3; robust t-statistics in parentheses; *, **, *** indicate the statistical significance at 10%, 5% and 1% respectively

Appendix figure II.1: Some relevant macroeconomic indicators, Iters vs Non-iters

Author's calculations based on data from IFS and WDI & GDF. Total investment is proxied by the gross fixed capital formation.

Chapter III

The Concern for Financial Stability in Inflation Targeting Regime: Evidence from Emerging Countries*

"*The recent crisis points up the weakness of the existing regulatory and supervisory regimes in many countries [...]*" (Woodford, 2012)

"*[...] the crisis has taught to us that central banks, when they set interest rates, should also be concerned about the fragility of the financial system.*" (Giavazzi and Giovannini, 2010)

I. Introduction

The two quotes above illustrate a debate which came to light in the aftermath the 2008/2009 global financial crisis. The financial regulatory system has been questioned, as has the monetary policy doctrine of the last two decades. The financial regulatory system failed to contain the growing financial bubble and has been ineffective in controlling financial innovations. Moreover, since the advent of the inflation targeting regime, central banks in

* A version of this chapter is currently under review in Economic Modelling.

most advanced economies, but also in an increasing number of emerging markets, have been assigned a primary objective of price stability. The short term interest rate setting is guided by the aim of maintaining the inflation rate around a specified target. This monetary policy framework has been called into question in the aftermath of the recent global financial crisis.

With CPI-inflation stability objective, a common view was that by focusing on inflation, monetary authorities are, to some extent, also dealing with the financial stability issue because financial imbalances should manifest through inflation.[50] The recent financial crisis proved this wrong. Indeed, the relatively low and stable inflation of the early 2000s did not prevent the global economy from the housing price bubble which crashed in 2008. This incoherence (stable inflation coupled with increasing financial risks) can be explained by the so-called "paradox of credibility" (Borio et al., 2003) which reflects the fact that financial imbalances might take longer to become apparent in increasing inflation rates because of better central banks' performances in anchoring long-run inflation expectations. Debate on the need for monetary policy rethinking is now widespread among academics as well as practitioners.

Inflation targeting has been criticized and considered as a potential source of the late 2000s crisis mainly because central banks have been less concerned with developments in financial markets and failed to prevent the crisis.[51] This raises two issues which are the main purposes of this chapter. The first is whether or not inflation targeting can actually be associated with higher financial instability, compared to other monetary policy frameworks. The second issue is whether inflation targeting central banks are less concerned with financial imbalances in their policy interest rate setting. These two questions have not yet been a subject to great attention in the academic literature.

As regards the issue of the "health" of the financial system in inflation targeting versus non-targeting countries, Frappa and Mésonnier (2010) is, to our knowledge, the only existing study which investigates the effect of inflation targeting on financial instability. Relying on a sample of 17 advanced economies, including 9 inflation targeters, their empirical tests based on variety of propensity score matching methods suggest that inflation targeting is associated

[50] Or at the best, financial stability objective is to be pursued with microprudential tools such as bank supervision and regulation, living more room for central to focus exclusively on inflation.

[51] See Frankel (2012), and CEPR (2013), among others.

with higher real house price and price-to-rent ratio. Considering the latter as indicators of financial instability, that is to say, the financial sector is relatively more unstable for countries which have adopted the inflation targeting strategy.

A common approach to investigate whether a central bank is concerned with financial imbalances is to estimate an augmented central bank reaction function (Taylor-type rules), including a measure of financial stability. Some studies assess this issue, particularly among advanced economies. Borio and Lowe (2004) argue that monetary policy would be more effective in achieving stable and low inflation if central banks were also sensitive to financial imbalances. They estimate augmented central banks' reaction functions (with financial variables) for Australia, Germany, Japan and the United States and conclude that there is no evidence of tightening monetary policy when financial imbalances build up. More recently, Castro (2011) investigates the extent to which the Bank of England, the FED and the European Central Bank are concerned with financial stability in their monetary policy-making. Estimating linear, non-linear and asymmetric augmented Taylor rules, his findings suggest that the European Central Bank is the only monetary authority which seems to tighten the policy stance when there are increasing financial imbalances. To the best of our knowledge, no such empirical investigations have yet been conducted among emerging countries, least of all studies aiming to compare targeters to non-targeters.

There is little consensus on the best way to account for financial issues in the monetary policy framework. First, central banks whose main goal is inflation stabilization may face a trade-off between this primary monetary policy objective and an additional financial stability goal (De Grauwe and Gros, 2009; Gali, 2014).[52] Second, even when it is agreed that the central bank should be concerned with financial imbalances, another issue is whether this should be clearly specified in its loss function (Disyatat, 2010), or merely considered as a new parameter in the reaction function but not as an objective per se (Bean, 2003). These issues are beyond the scope of our investigation in this chapter.

The chapter contributes to the existing literature in three main points. First, we build a composite index of financial instability, providing a more complete and comprehensive view of the financial conditions in emerging countries (rather than relying on a single indicator

[52] This issue is discussed in more details in chapter IV.

such as credit growth or credit to GDP ratio). Second, we shed light on the assumption that inflation targeting might be associated with higher financial fragility. And third, as a first attempt in this literature on emerging markets, we investigate whether inflation targeting central banks in emerging market economies are less responsive to financial imbalances compared to their non-targeting counterparts.

The empirical tests are conducted on a sample of 26 emerging countries including 13 targeters,[53] with quarterly data spanning from 2000Q1 to 2010Q4. Relying on selected basic indicators of financial risks, as well as our composite index of financial instability, the findings show that countries implementing the inflation targeting strategy are, on average, relatively more financially unstable than non-targeting countries. Comparing the two groups with respect to the central banks' reaction functions, we find that contrary to their counterparts, inflation targeting central banks respond to financial imbalances through policy tightening. The assessment of the country-by-country central banks' reaction functions reveals that for 8 of the 13 inflation targeters, the monetary authorities are concerned with financial issues in their policy-making (at variance with criticism on this monetary policy regime). Overall, the empirical investigation suggests that despite the main monetary policy instrument's response to financial imbalances, targeting countries are financially more fragile. This calls into question the relevance to rely on the standard monetary policy framework as a way to address the financial instability issue, as greater financial vulnerability in targeting countries can hardly be attributed to central banks' lack of concern with developments in the financial sector.

The chapter is organized as follows. Section II sets a first statistical and empirical analysis of the financial stance in targeting and non-targeting countries. In section III, we discuss some relevant issues related to the measurement of the financial conditions and construct a composite index of financial instability. We further assess whether the inflation targeting adoption is positively correlated with financial instability. Section IV investigates the extent to which the monetary authorities are concerned with financial issues when setting their policy interest rate. Finally, section V concludes.

[53] See appendix table1.

II. Preliminary analysis: financial conditions in targeting *vs* non-targeting countries

This section intends to carry out a preliminary analysis of the financial conditions in emerging countries, comparing inflation targeters to non-targeters. Based on a set of selected indicators capturing the health of the financial sector, the first subsection focuses on a statistical comparison across regions (Asia, Europe, Latin America, and Middle East and Africa). Next, we set a first empirical framework to assess the extent to which the inflation targeting regime can be associated with higher financial fragility.

II.1. Some stylized facts

Our sample of 26 emerging markets economies is split into 4 regional groups: Asia includes Korea, Philippines, and Thailand among inflation targeters and Malaysia, Russian Federation, and Singapore for non-targeters. Europe consists of Czech Republic, Hungary and Poland for targeting countries and Bulgaria Croatia and Ukraine for non-targeters. In Latin America, inflation targeters are Brazil, Chile, Colombia, Mexico and Peru while non-targeters are Argentina and Venezuela. Finally, the Middle East and Africa group includes Isreal and South Africa among inflation targeters and Bahrain, Kuwait, Morocco and Nigeria among non-targters. To assess the financial conditions in each of these groups, we rely on set of basic indicators, mainly related to the banking sector and capturing various aspects of risks in the financial system.[54]

Credit to GDP ratio is measured as the banking system's claims on private sector, expressed as a share of GDP. Credit aggregates (including other considerations such as credit to GDP gap or credit to GDP growth) are commonly used indicators of financial fragility in the existing literature. The Basel Committee on Banking Supervision (2010) stresses that credit related variables perform very well in reflecting the risk in the financial system. Particularly, credit to GDP is considered as a leading indicator among others because, being expressed as ratio of GDP, it has the advantage (over credit growth for example) to be normalized by the size of the economy, allowing to control for the normal cyclical pattern of credit demand.

Systemic liquidity is defined as the ratio of bank credit to total deposit. This indicator captures the extent to which bank credit expansion relies on resources other than bank deposit.

[54] Appendix table 7 provides data sources.

Following Lim et al. (2011), it is used as a proxy for banks' resort to non-core funding. The main source of funding available to banks is households' deposits. But the latter strongly depends on the economic conditions and particularly on the wealth of households. When the growth in bank loans is higher than deposits available, banks turn to others sources of funding such as capital market (non-core liabilities). According to Hahm et al. (2012), an expansion of non-core liabilities in the banking sector increases financial vulnerability and the exposure to a crisis.

Credit growth is the growth rate of bank claims on private sector. Credit growth captures the cyclical fluctuations in domestic bank loans. Rapid credit growth may tend to be associated with increasing financial and macroeconomic instability, but also with declining loans standard and growing risk. Moreover, the growing financial imbalances which can be linked to credit booms often result in financial crises, as highlighted by Elekdag and Wu (2011) how show that rapid credit growth end abruptly and is strongly associated to crises in emerging countries.

Capital flows is the ratio of bank foreign assets to total assets. This indicator captures the banking sector exposure to adverse external financial shocks. The 2008/2009 global financial crisis has shown how domestic economies can be largely affected by external shocks, especially when banks and other financial institutions are strongly integrated into the international financial system. The higher the financial institutions' involvement in the international financial markets, the higher the vulnerability of the domestic financial system to adverse global shocks. An increase in foreign assets (capital outflows) relative to total assets may also capture the extent to which banks are confident with regard to the domestic financial environment. In this later case, an increase in the ratio may suggest a perceived deterioration in domestic financial investments. Moreover, in emerging countries, increase in capital outflows is more generally considered as harmful for the financial system stability.

Share price index is a composite index capturing developments in the stock market. Rapid growth/change in the share price index can be a source of concern since it may signal formation or amplification of a financial bubble. More specific indicators such as house prices or asset prices are commonly used in the literature and certainly provide more accurate information on financial risks. But such data are much less available for the particular case of emerging countries.

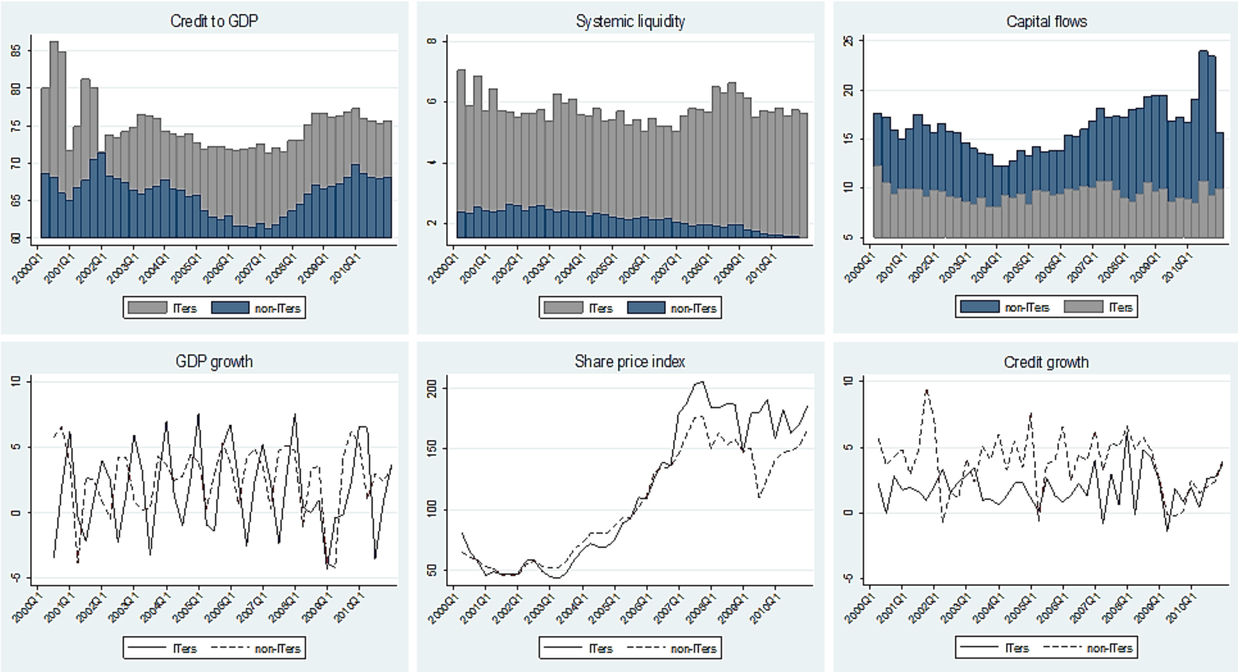
Figure III.1 graphs the above financial indicators by regional groups, for targeting and non-targeting countries. The figure also presents the GDP growth path within these groups. The economic cycle seems to be relatively similar for targeters and non-targeters in the four regions, as suggested by changes in the growth rate of GDP over the covered period. Differences in fluctuations of the economic activity are not statistically significant between targeters and non-targeters. This first observation is of relevance since the economic cycle may be closely related to, or considered as a strong determinant of the financial cycle. The common path of the economic cycle between inflation targeting countries and the others may therefore ease the comparison of their financial conditions, as differences may underline primarily different behavior in the financial sector.

When looking at credit to GDP, the ratio is significantly higher on average for inflation targeting countries, except in Europe. The gap between targeters and non-targeters is larger in Middle East and Africa. The ratio averages 40% until early 2007 and does not exceed 60% later on, for non-targeters. Conversely, the minimum ratio for targeters is around 80%, with a maximum of 130% at the beginning of the period. Although the credit to GDP is much lower in Latin America (compared to Middle East and Africa), the difference between targeters and the others remains large. The ratio goes from 30 to around 40% for inflation targeting countries while it is only between 10 and about 20% for non-targeters. The picture in Asia is somehow between those of the two later regions. Overall, the credit to GDP ratio is lower compared to Middle East and Africa, but higher than the ratio in Latin America. However, the gap between targeters and non-targeters in Asia is less pronounced, around 10 percentage points. On average, the ratio is close to 75% for Asian inflation targeters and 65% for non-trageters.

Finally, it does not seem to be a significant difference between the two groups in Europe. Although the ratio is higher for targeting countries during the two first years, the trend looks very similar for the rest of the period. Contrary to the credit to the GDP ratio, the credit growth depicts a similar pattern for all regional groups. The growth rate is about 2 percentage points higher for non-inflation targeting countries, compared to targeters.

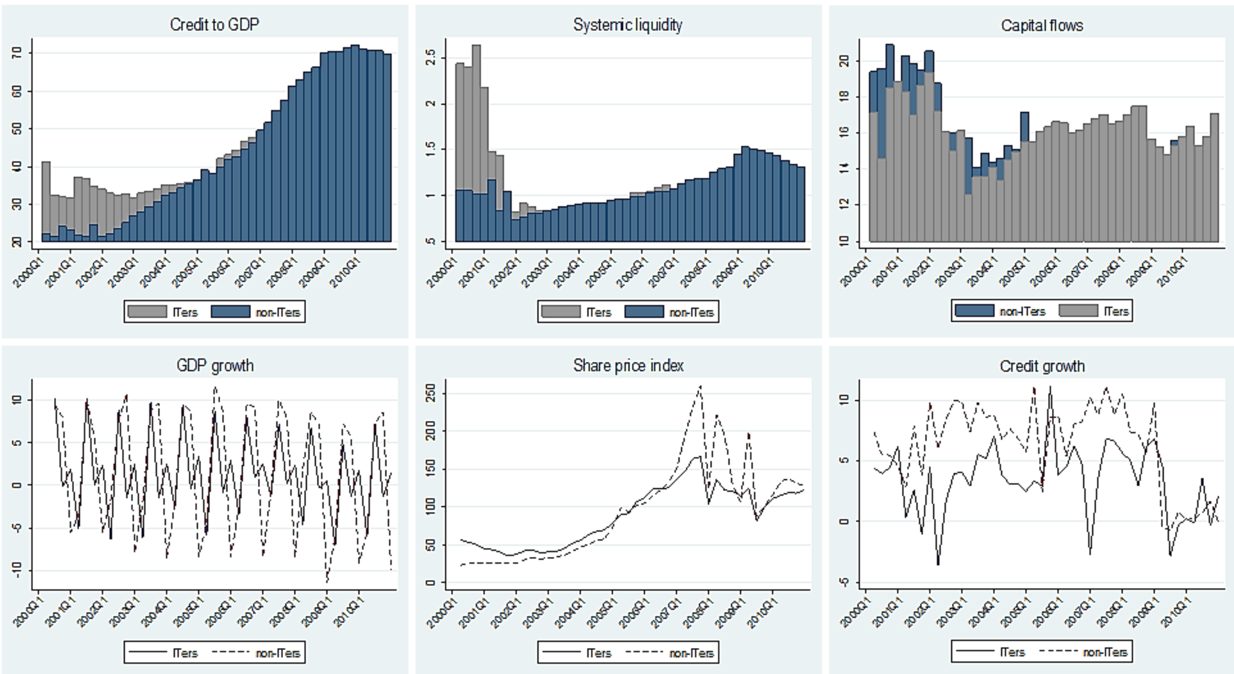
Figure III.1: Selected financial indicators and GDP growth, regional groups[55]

Asia



(**Korea Republic**, Malaysia, Pakistan, **Philippines**, Russian Federation, Singapore, **Thailand**)

Europe

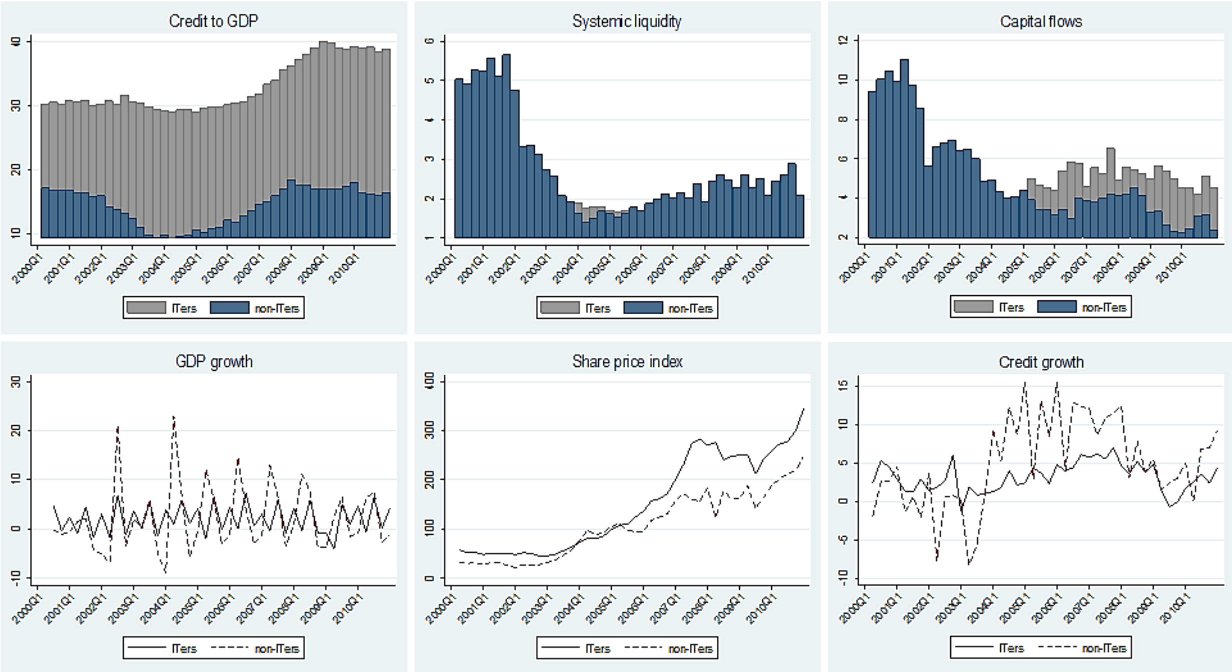


(Bulgaria, Croatia, **Czech Republic**, **Hungary**, **Poland**, Ukraine)

[55] Inflation targeting countries in bold; see appendix table 7 for data sources.

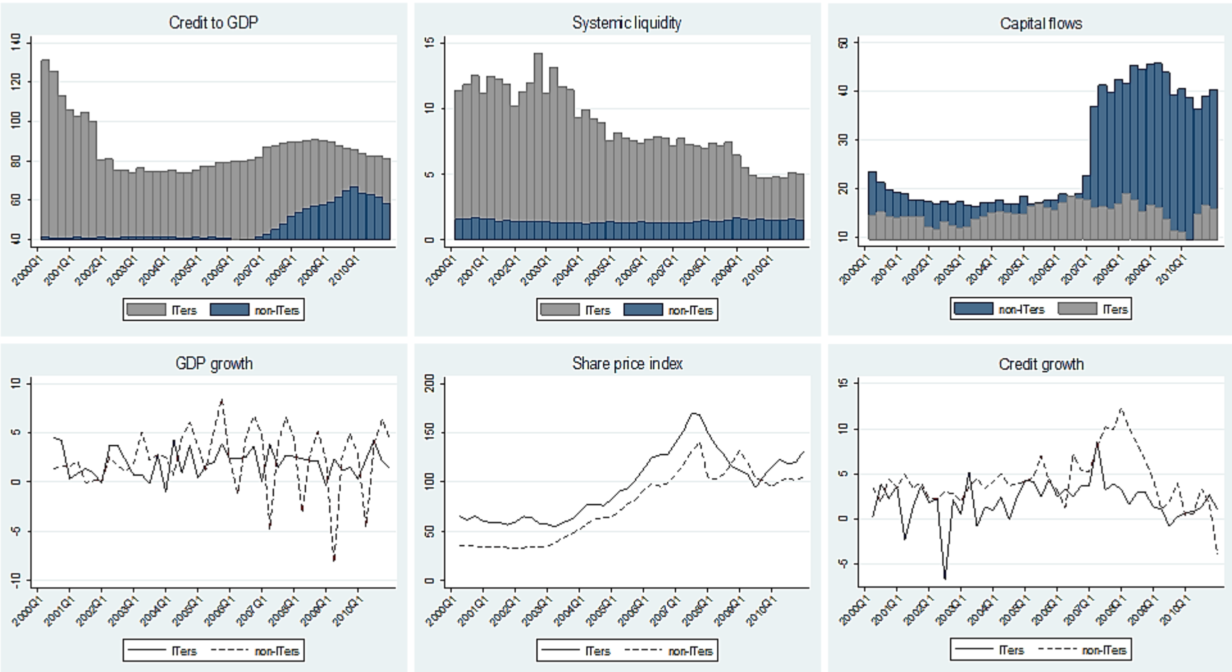
Figure III.1 (continued)

Latin America



(Argentina, **Brazil**, **Chile**, **Colombia**, **Mexico**, **Peru**, Venezuela)

Middle East and Africa



(Bahrain, **Israel**, Kuwait, Morocco, Nigeria, **South Africa**)

Regarding systemic liquidity, our proxy for the use of non-core funding in the banking system, significant differences also emerge between targeters and non-targeters. The picture looks alike in Asia and Middle East and Africa; the credit to deposit ratio is significantly higher in inflation targeting countries. In the latter two regional groups, total bank loans represent on average twice the total of deposits, for non-targeting countries. For targeters, loans are respectively about six and eight times higher than the total deposits, in Asia and Middle East and Africa. Clearly, in these two regional groups, the resort to non-core liabilities is much more important in inflation targeting banking system. An opposite situation emerges in Latin America; systemic liquidity is significantly lower for inflation targeting countries. The total loans is less than twice as large as the total deposits for targeters, while it is roughly three times larger for non-targeters. In Europe, as for the credit to GDP ratio, systemic liquidity shows a very similar trend in targeting and non-targeting countries (except for the first quarters of the studied period). The credit to deposit ratio is, on average close to one, suggesting that loans are almost as large as deposits.

As far as the banking system's external exposure is concerned, the capital flows index suggests that there is no significant difference between targeters and non-targeters in Europe and Latin America. On average, foreign assets represent 16% of the banks' total assets in Europe, and 5% in Latin America. In Asia and Middle East and Africa, non-targerting countries seem to be relatively more engaged in foreign investments. Indeed, in Asia, the share of bank total assets held abroad is 16% percent for non-targeters and 10% for targeters, on average. The gap is larger in Middle East and Africa. The banking sector foreign assets represent about 15% of the total assets for inflation targeting countries, and more than 26% for non-targeters. The higher share of foreign assets for non-taregting countries in Asia and Middle East and Africa, is mostly driven by Singapore and Bahrain respectively. These two countries are well known financial centers, and their banking systems are more closely interconnected with the international financial markets. Excluding those two countries from their regional subsamples considerably changes the picture between targeting and non-targeting countries.

As regard the stock market, the share price index exhibits a common trend across regions. The index grows relatively fast from the early 2000s to mid-2007 where it stabilizes and declines (exhibiting higher fluctuations) between 2008 and 2009. The fluctuations and the decline in the share price index in 2008-2009 correspond to the period of the widespread financial instability faced by the global economy in the late 2000s. Emerging markets have also been affected by this global financial crisis, although in a lesser extent than industrialized economies. Comparing targeters and non-targeters, there is no significant difference between the two groups in Asia and Europe (although the index is higher in the last three years for targeters in Asia, and non-targeters in Europe). Conversely, the index seems to grow faster for targeting countries in Latin America and Middle East and Africa.

Based on simple basic financial indicators, this preliminary statistical analysis shed light on the financial conditions in emerging countries, stressing some significant differences between inflation targeters and non-targeters. Overall, in spite of regional specificities, these indicators seem to provide prima facie evidences showing that inflation targeting countries may face higher financial fragility than non-targeting countries. Indeed, while the economic cycle is akin for the two the groups, the indicators suggest stronger concern about financial instability in targeting countries, an issue we attempt to assess more rigorously in the next subsection.

II.2. A preliminary empirical investigation

II.2.a. The analytical framework

This subsection aims at investigating whether or not the adoption and the implementation of the inflation targeting regime can be associated with higher financial fragility. The statistical analysis conducted in the previous subsection, while suggesting, on average, greater concern for financial vulnerability in targeting countries, does not allow establishing a causal relationship between this monetary policy regime and the financial conditions. Other factors than the adoption of inflation targeting can explained the observed statistical differences between the two groups. In order to carefully infer on the relationship between inflation targeting and the financial indicators, we need to control for those factors. To this end, we rely on an econometric analysis in which the estimated model can be specified as follow:

$$\log(y_{it}) = \alpha + \beta IT_{it} + \Theta \log(X_{it}) + \Psi D_i + \varepsilon_{it} \quad (1)$$

where y_{it} is an indicator of the financial conditions, IT_{it} is a dummy variable which takes the value of 1 for country i at period t if the given country is classified as an inflation targeter, X_{it} is the vector of time-varying, country-specific factors affecting the considered financial indicator, D_i is the vector of regional dummies, and ε_{it} is an error term. α, β, Θ, and Ψ are the model parameters to be estimated. The log-specification of this equation allows interpreting the parameters associated with the explanatory variables (the *X*s) as direct elasticities.

For the purpose of this econometric investigation, we consider four financial indicators, namely (the log of) credit to GDP ratio, systemic liquidity, capital flows and share price index. The regressors of the model (vector *X*) include:

GDP growth, which can be expected to be positively correlated with the financial cycle. Financial imbalances are often procyclical, because good economic growth performances may feed unrealistic expectations about the future path of the economy, increasing risk taking behavior.

Real GDP per capita is used as a proxy for countries' economic development. The correlation with the financial indicators is expected to be positive, since the more developed economies are also relatively more financially developed and certainly involved in more risky financial activities. Besides, the more developed economies are highly integrated to the global financial system and more vulnerable to external financial shocks.

Inflation rate can be expected to heighten financial instability, as higher inflation can increase uncertainties, hampering the efficiency of the financial system. For financial institutions, increasing inflation complicates the risk management because it blurs expectations. Increasing inflation may also reduce confidence to domestic investments, favoring capital outflows. Besides, controlling for the rate of inflation allows capturing more accurately the effect of inflation targeting since emerging market targeters enjoy significantly lower level of inflation, compared to their non-targeting counterparts (appendix figure III.2).

Short term interest rate captures the monetary policy stance. It is argued that loose monetary policy (low interest rates) can favor financial imbalances by raising risk taking (see Borio and Zhu, 2012 among others). In this regard, the short term interest rate is expected to have a negative effect on financial instability. Particularly, the increase in the short term interest rate should reduce the credit to GDP and credit to deposit ratios, but also the changes in the share price index. By raising returns on domestic assets, increase in the short term rate will also lower the incentive to purchase foreign assets, thereby limiting the exposure to external shocks.[56]

Total deposits as a share of GDP can affect the credit to GDP and systemic liquidity in different ways. Increase in deposits provides the banking system with additional funding capacity for their loan activity and may consequently feed an increase in credit to GDP ratio. Conversely, the increase in deposits can reduce the need for non-core liabilities, lowering the systemic liquidity index.

Lending rate controls for the cost of credit. It is expected to be positively correlated with the credit supply, since higher lending rate increases bank profit margins, and can therefore raises incentives to lend. On the demand side, higher lending rate is expected to be negatively correlated with incentive to borrow, reducing total credit in the economy.

Deposit rate captures the cost of banks core-liabilities. Others things equal, an increase in deposits rate raises the cost of core funding and may increase the banks incentives to resort to others forms of resources (non-core liabilities).[57] Deposit rate also allows controlling for an alternative investment (for households or investors) to shares purchase on stock markets. In this regard, an increase in the deposit rate may be associated with lower share price index.

Real exchange rate is expected to be positively correlated with credit to GDP and systemic liquidity, but negatively with capital flows. Currency appreciation may favor credit supply because it may ease access to external funding for the banking system. Conversely, domestic currency appreciation will reduce to incentive to invest abroad, especially in foreign currency.

Bank foreign liabilities as a share of GDP (capital inflows) can increase financial imbalances by feeding the credit supply. Foreign liabilities are expected to be positively correlated with credit to GDP and systemic liquidity (increase in non-core liabilities).

M2 growth controls for liquidity in the economy. It is assumed that higher liquidity can increase financial risks through the increasing in share prices in the stock market (positive correlation with the share price index).

[56] These issues are also discussed in chapter I and II.

[57] Increase in deposit rate may increase households' incentive to save, thereby decreasing the credit to deposit ratio. In this case, a negative correlation is expected between deposit rate and systemic liquidity.

FED fund rate captures the global liquidity conditions. An increase in the FED fund rate raises incentives to invest abroad and, by so doing, increases the domestic financial sector vulnerability to external shocks. The FED fund rate is expected to be positively correlated with capital flows.

Finally, the *Economic globalization* index captures the degree of openness to the global economy. This index should have a positive effect on capital flows since the banking sector of more opened economies will tend to be more engaged in external financial transactions.

II.2.b. Results

An issue in the estimation of equation (1) is the endogeneity bias. In this model, at least two sources of endogeneity can emerge: the reverse causality between the explanatory and the dependent variables, and the omitted variables bias. In that case, the ordinary least squared estimates are biased. To overcome this issue, we rely on an instrumental variable approach: the two stages Generalized Method of Moment (GMM). This method has the advantage (over the traditional two stages least squared method) to provide efficient estimates of the coefficients and consistent estimates of the standard errors. All the *X*s are potentially endogenous, and makes it difficult to find external instruments. Alternatively, we used the first and/or the second order differences of the explanatory variables as instruments. This approach performs better than the instrumentation with lagged variables (as suggest by the Hansen J-test) because the correlation between the residual term and the lagged variables may be stronger than the correlation with first or second order differences. Besides, this approach requires a lower number of instruments to fit the model.

Table III.1 provides the estimates results. For each financial indicator, we consider a first estimation on the overall studied period and another on the period preceding the global financial crisis (2000Q1 – 2008Q2). Almost all the control variables show strongly significant coefficient with the expected effect, except for GDP growth for which the effect does not seems to be robust. The coefficient associated with the *IT* dummy is also strongly significant and shows a positive effect of inflation targeting on credit to GDP ratio, systemic liquidity and share price index, but a negative effect on capital flows. In other words, on average, the adoption and the implementation of inflation targeting is associated with higher credit to GDP ratio, higher credit to deposit ratio, higher share price index, but lower banks' foreign assets to total assets ratio.

Assuming that these financial indicators capture some forms of financial imbalances or financial instability, the estimates results provide mixed conclusions regarding the effect of inflation targeting regime. On the one hand, inflation targeting seems to be strongly associated with higher "domestic" financial instability (larger gap between the domestic credit trend and the economic activity, higher banks requirement to non-core liabilities, and potentially higher risk on the stock markets). On the other hand, the adoption of inflation targeting reduces the vulnerability to external financial shocks, since it is associated with lower banks foreign assets as a share of total assets.

Regarding the other control variables, as expected, countries' level of development (proxied by the real GDP per capita) is positively associated with the financial indicators, except for systemic liquidity. This suggests that the more developed economies are also the more financially vulnerable. Although counterintuitive, the negative effect on systemic liquidity might be explained through the relation between the economic development and the households' saving behavior. Indeed, in more developed economies, households will probably save more, increasing bank deposits and lowering the credit to deposit ratio. Inflation rate has a positive effect on all the financial indicators, except credit to GDP ratio. The negative relationship between inflation and credit to GDP could find an explanation in the fact that higher inflation lowers the real lending rate, reducing the banks' margin and incentives to supply loans. The lending rate is positively associated with the credit to GDP ratio, consistent with our argumentation. The short term interest has a negative impact on the credit to GDP ratio, systemic liquidity and share price index, as expected. The effect on capital flows is not significant.

The total deposits as a share of GDP fosters the credit to GDP ratio, but lowers systemic liquidity. Consistent with the assumption that the deposit rate captures the cost of core-funding in the banking sector, it is positively correlated with systemic liquidity. Conversely, the effect of deposit rate on the share price index is negative, suggesting that saving in the banking system may be perceived as an alternative investment to share purchases. The growth in M2 aggregate is a positive determinant of the share price index. Increasing liquidity can contribute in an acceleration of the share prices on the stock market through higher demand.

In the same vein, the credit to GDP ratio is also positively correlated with the share price index, consistent with a commonly accepted view that loans supply can fuel asset price and potentially generate an assets price bubble.

Table III.1: Effect of inflation targeting on selected financial indicators

Dependent variables	Credit to gdp ratio		Systemic liquidity		Capital flow		Share price index	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
IT	0.249***	0.304***	0.420***	0.510***	-0.220***	-0.209***	0.226***	0.190***
	(10.19)	(9.680)	(9.143)	(9.204)	(-3.402)	(-3.083)	(4.249)	(3.505)
Gdp growth	-0.00829	0.122	-0.393*	-0.183	-0.582**	-0.441	0.260	0.273
	(-0.0533)	(0.682)	(-1.729)	(-0.655)	(-2.007)	(-1.516)	(0.729)	(0.748)
Real gdp per cap.	0.323***	0.330***	-0.0803***	-0.0771***	0.346***	0.325***	0.0629***	0.0807***
	(29.90)	(27.77)	(-4.641)	(-3.902)	(14.04)	(12.93)	(2.931)	(3.967)
Short term rate	-0.134***	-0.198***	-0.330***	-0.452***	0.0417	0.0514	-0.103*	-0.0943
	(-6.921)	(-6.168)	(-7.766)	(-8.194)	(1.259)	(1.545)	(-1.843)	(-1.560)
Inflation rate	-0.911***	-1.210***	1.281***	1.588**	1.438***	1.281***	2.722***	2.030**
	(-2.963)	(-3.001)	(2.755)	(2.472)	(3.017)	(2.714)	(3.156)	(2.276)
Real exchange rate	0.511***	0.644***	1.308***	1.547***	-0.441**	-0.357		
	(7.722)	(6.917)	(10.17)	(8.848)	(-2.126)	(-1.634)		
Foreign liabilities	0.104***	0.0959***	0.394***	0.396***				
	(9.458)	(8.784)	(20.36)	(17.20)				
Total deposit	0.247***	0.255***	-0.608***	-0.601***				
	(20.80)	(18.11)	(-28.27)	(-22.96)				
Lending rate	0.147***	0.185***						
	(4.851)	(4.723)						
Deposit rate			0.163***	0.187***			-0.140***	-0.151***
			(4.031)	(3.622)			(-2.733)	(-2.785)
Fed fund rate					0.0934***	0.0873**		
					(2.757)	(2.338)		
Eco. globalization					1.110***	1.133***		
					(8.437)	(8.294)		
M2 growth							2.234***	2.230***
							(3.521)	(3.455)
Credit to gdp							0.287***	0.299***
							(5.256)	(5.329)
Capital flow							-0.0419	-0.0505
							(-1.150)	(-1.399)
Constant	-0.872***	-1.524***	-3.594***	-4.577***	-1.463	-1.911*	3.519***	3.466***
	(-2.705)	(-3.188)	(-6.140)	(-5.563)	(-1.392)	(-1.732)	(13.17)	(12.64)
Regional dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	878	636	860	628	720	674	630	563
Adjusted R^2	0.753	0.759	0.705	0.722	0.605	0.593	0.184	0.206
F test	0	0	0	0	0	0	0	0
Hansen J-test	0.988	0.935	0.461	0.661	0.733	0.928	0.838	0.589

Two stages GMM estimates of equation (1). The list of instruments includes the second order difference of the explanatory variables. P values of F-test and Hansen J-test are reported. The F test is a test of the null hypothesis that all the coefficients, except the constant, are jointly significant. The Hansen J-test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses.***, **, * indicate the statistical significance at 1, 5 and 10% restively. For each dependent variable, estimates in column (1) and (2) cover the period 2000Q1-2010Q4 and 2000Q1-2008Q2, respectively.

Regarding the external factors affecting the financial conditions, the FED fund rate is found to have a positive effect on capital flows. Higher international interest rate can be a sign of a higher return on foreign assets, and this is likely to increase banking sector incentives to acquire foreign assets. Bank foreign liabilities (capital inflows) increase both the credit to GDP ratio and systemic liquidity. Foreign liabilities provide the banking system with more funding for their loans activities. As non-core liabilities, it may be associated with higher financial vulnerability. The economic globalization index is positively correlated with capital flows, suggesting that more opened countries to the global economy are more vulnerable to external shocks. Finally, the impact of the real exchange rate on credit to GDP and systemic liquidity is positive, but negative on capital flows. These results are consistent with our assumption that currency appreciation can favor access to external funding, feeding domestics credits. On the contrary, currency appreciation will make foreign investments less attractive, reducing the share of foreign assets.

III. Inflation targeting and financial stability: an appraisal

The previous section provides a general overview on the relation between the inflation targeting regime and financial stability. The financial conditions have been assessed through a set of basic indicators, mostly referring to the banking system. While such single indicators may provide reliable information regarding specific risk in the financial sector, taken separately, they certainly do not allow capturing accurately the financial stance. A more rigorous assessment of the financial conditions may require approaches covering a combination of a large set of indicators which may be highly correlated to each other. This raises the concern of the definition and the measurement of financial stability, discussed in the present section. First, we shed light on some critical issues in measuring financial stability and provide a composite financial condition index for our sample of emerging countries. Second, with this composite index, we reassess the extent to which targeters and non-targeters may perform differently in terms of financial stability.

III.1. On the assessment of the financial conditions

III.1.a. Issues in measuring financial (in)stability

According to Borio and Drehmann (2009), financial instability is "*a set of conditions that is sufficient to result in emergence of financial distress/crises in response to normal-size shocks*" (the shocks can originate from the real economy as well as the financial system itself). A variety of indicators are used in the literature to assess financial (in)stability; from individual financial institutions' characteristics (related to their balance sheet) to macroeconomic data. Gadanecz and Jarayam (2009) provide a review of those variables. Six main categories are identified.[58] Existing studies which empirically investigate the countries' financial stance rely on alternative strategies. While some of those studies mainly focus on a single variable as mean of assessing countries financial conditions (for example, Frappa and Mésonnier, 2010 use the housing price), others combine information from a number of financial and macroeconomic indicators to construct a composite index (Brave and Butters, 2011 rely on a set of 100 indicators for their composite financial condition index). Composite indices have the advantage of aggregating information from a variety of financial variables capturing specific risks. In this regard, they can be expected to reflect more faithfully the countries' financial conditions than a single indicator such as banking sector credit, house price or asset price.

Building a synthetic index nonetheless raises the issue of the aggregation technic. Again, various approaches emerge from the existing literature. Broadly speaking, two types of strategies can be identified. The first relies on econometric and/or economic simulations, based on macroeconomic models. Using a reduced form model and VAR impulse responses, Goodhart and Hofmann (2001) construct a financial condition index for the G7. Another economic-based approach for credit risk consists in assigning weights to each market depending on its relative importance regarding the total credit in the economy. The second

[58] (1) Real economy includes GDP growth, fiscal position of governments, and inflation. (2) The corporate sector includes total debt to equity, earnings to interest and principal expenses, net foreign exchange exposure to equity, and corporate defaults. (3) The households sector includes household assets, debt, income, consumption, debt service, and principal payments. (4) External sector includes exchange rate, foreign exchange reserves, current account, capital flows, and maturity/currency mismatches. (5) The financial sector includes monetary aggregates, interest rate, growth in bank credit, bank leverage ratios, nonperforming loans, risk premium, capital adequacy, liquidity ratio, standalone bank credit ratings, and banking concentration. (6) Financial markets variables include change in equity indices, corporate bonds spread, market liquidity, and house price.

category basically stems from statistical analyses. It includes simple factor analysis (Illing and Liu, 2006) and dynamic factor analysis. The latter allows dynamic changes in weights associated with individual indicators entering the composite index (see for example Klomp and de Haan, 2008). Also included are principal component analysis (Brave and Butters, 2011), variance equal weight which assigns the same weight to each individual variable in the composite index, or sample cumulative distribution functions.

Little consensus emerges regarding the best strategy for combining a set of variables into a synthetic index. Each approach has its own pros and cons. Approaches based on economic models rely entirely on a particular description of the economy and some (potentially strong) hypothesis. As a result, the validity of the constructed index depends on the credence one may have regarding this given description of the economy. Assigning weight to each indicator depending on their relative importance for a specific financial segment seems to be an attractive approach. However, by focusing on a particular segment of the financial system, this approach restricts the eligible variables to be used and, by definition, may exclude other relevant determinants of the overall financial stance.

The statistical-based approaches certainly rely on weaker assumptions as they are mainly based on correlations, variance and covariance analyses. However, there is scope for criticism because of the lack of economic foundations. Variance equal weight assigns the same weight to each individual indicator. As a consequence, the obtained financial condition index may not reflect the real state of the financial environment because some sectors or variables are more informative than others, as they play a more prominent role in the financial developments. For instance, in less financially integrated developing countries, currency mismatch will probably be less relevant to the financial environment (compared to credit growth for example). Besides, depending on the issue considered, some statistical analysis may not be suitable. In particular, dynamic factor analysis would be misleading for the purpose of our study because it allows changes in individual indicators' weights each period of time.[59] All these arguments having been considered, principal component analysis (PCA) is the chosen methodology to build our composite index.

[59] In the next section, the constructed index will enter the central banks' reaction functions. The implementation of dynamic factor analysis in this particular case may suggest that central banks redefine period by period (here, from one quarter to another) the importance that should be assigned to each individual indicator entering the financial condition index. We believe this would be a fairly strong assumption.

PCA is one of the common statistical approaches used for data reduction. It aims to explain the variance of observed data through a few linear combinations of the original dataset. It may be needed to condense information contained in a large set of variables into one (or smaller number of) indicator(s) which will account for most of the variance in the original dataset. The basic assumption is that, in their fundamentals, these variables reflect some redundant information that can be extracted. This common information will likely be easily manageable and interpretable than using the original dataset. In other words, PCA allows the extraction of needed information (common to a number of variables) and abstracts from the remaining noise.

III.1.b. Building the composite financial conditions index

Fundamental differences exist between emerging markets and industrialized economies regarding the financial sector's characteristics. These differences should be accounted for, when assessing the financial stance. Emerging countries are characterized by lower financial development and less sophisticated financial instruments. The stock markets are certainly less active and the banking system embodies a larger share of financial activities. Another characteristic of emerging markets is their higher vulnerability to external shocks, such as exchange rates fluctuations and the flows of international capitals. The exchange rate risk is mainly related to foreign currency denominated liabilities. Most governments face an inability to borrow abroad in domestic currency (the so-called "original sin"). This is also relevant for financial institutions, particularly the banking system. Large surges of international capitals to emerging countries could negatively affect their financial system, particularly when the flows are highly volatile. Likewise, sudden stops of capital inflows and/or sudden increases in outflows can have important destabilizing effects.

For the purpose of our "macro-financial condition index" (MFCI), we rely on a set of 8 variables[60] related to the banking sector, the stock market and the macroeconomic environment.

[60] Other relevant variables related to banks' balance sheets, assets or real estate markets for example are also informative when assessing the stability of the financial system. Most of those variables are not included in our analysis due to data limitations for emerging countries. Besides, given the purpose of the study, other variables such as inflation or exchange rate are not included since they enter the central banks' reaction functions.

As regards the banking system, in addition to *credit growth*, *systemic liquidity* and *capital flows*, discussed in the previous section, the following indicators are considered:

- *Interest rate spread* which is the square of the difference between bank lending interest rate and money market rate. Higher and increasing gap between the short term and the lending rate can reflect growing tensions in the credit market and result in an intensification of the financial system fragility.

- *Net foreign assets growth* is the growth rate of the banking sector net foreign assets. While capturing to some extent the banking sector exposure to external financial shocks, this indicator mainly accounts for the cyclical behavior of the banking system with regard to international financial transactions. Compared with the *capital flows* index, this indicator also controls for foreign liabilities (capital inflows).

Developments on stock markets are captured by the *share price index*, as defined in the previous section.

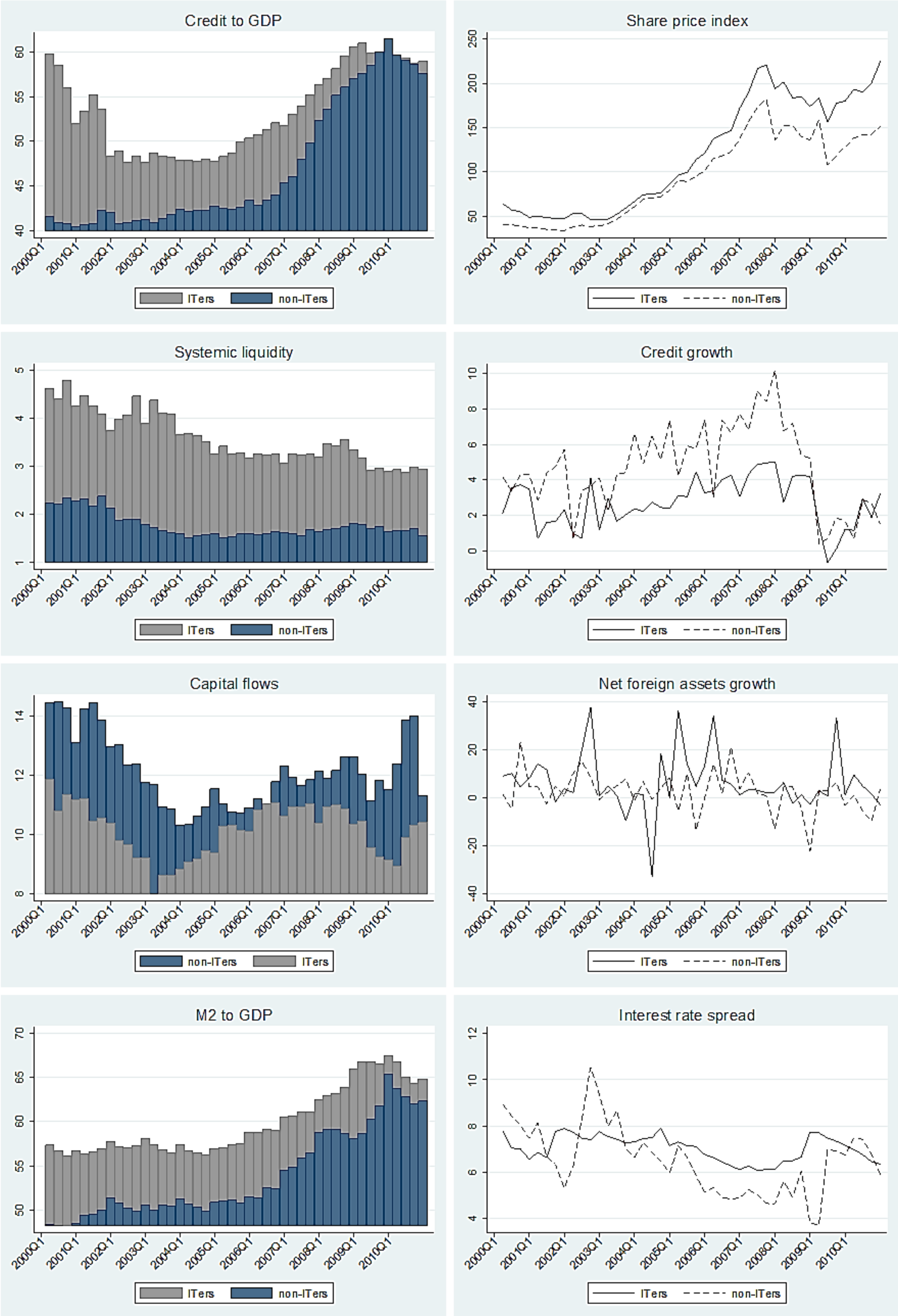
At the macroeconomic level, in addition to the *credit to GDP ratio*, we consider

- *M2 to GDP ratio*[61] which is used as a proxy for liquidity. Increase in liquidity available may be harmful for the financial system as it is often associated with low interest rates and increasing risk taking. The increasing global liquidity couple with low interest rates (especially in the U.S.) of the early and the mid-2000s have been pointed as a source of the financial bubble which crashed in 2008.

Figure III.2 depicts the changes in these variables over the covered period, for the two groups. It suggests that, except for credit growth and capital flows, the other indicators are, on average, significantly higher in inflation targeting countries.

[61] M3 aggregate may be a more complete measure of liquidity, but data are less available for emerging countries.

Figure III.2: Financial indicators considered for the FMCI



See appendix table III.7 for data sources

To combine the above 8 indicators into a single index, we apply the PCA. As is usual practice, we build the correlation matrix between these indicators (appendix table III.2). The findings suggest that the correlation coefficients are almost all statistically significant at least at the 5% significance level, highlighting the close connections between the individual (financial instability) indicators. This strong correlations also emphasizes the relevance of the PCA as a method to extract the common component to these variables which will provide us with a more complete and comprehensive overview of the financial conditions. Importantly, the PCA is performed by country in order account for possible disparities in our sample. The PCA is used to determine the weights which should be associated to each indicator entering the composite index. Although our sample consists of emerging markets economies, their financial environments exhibit some important differences. For example, some countries such as Singapore or Kuwait are relatively more engaged in international financial transactions (more vulnerable to external financial shocks) than, say, Morocco or Malaysia. Accordingly, when building the index of the financial conditions, external factors (such as *capital flows*) may deserve higher weight in Singapore compared to Morocco.

As it is a common practice in the literature performing this technic of data reduction, in order to ease the interpretation, we keep the first factor of the PCA. The first factor accounts for the highest share of the total variance of the original data set. Precisely, depending on the country considered, this first factor account for 62 to 40% of the total variance (with exception of 3 cases where the variance is between 33 and 36%). The common criteria for factors selection in the PCA are met: the ‘Kaiser criterion’ which recommends to keep factors with eigenvalue higher than 1, or the criterion recommending to keep factors with individual contribution to the total variance higher than 10% (see appendix table III.3). In the end, for country *i* in period *t*, our macro-financial condition index is constructed as follows:

$$MFCI_{it} = \sum_{n=1}^{8} \omega_{in} x_{\mathrm{int}} \qquad (2)$$

Where the ωs are the *n* loadings (weights) generated from the PCA, and the *x*s are the *n* individual indicators (the 8 variables listed above), standardized with 0 mean and 1 standard deviation. The time-varying MFCI obtained is rescaled to vary from 0 to 1 in order enhance interpretations in our empirical work. An increase in the composite index suggests a deterioration of the financial conditions.

As a first step in analyzing the relevance of the composite index, we graph the MFCI by country (appendix figure III.1) to see its pattern over the studied period. An obvious observation to be made is the shape of the index during the late 2000s global financial crisis (especially in late 2009). For most countries, the financial instability indicator clearly suggests an increasingly deterioration of the financial conditions since the mid-2000s (increase in the index, suggesting risks accumulation). This is in line with the common argumentation supporting that the period preceding the global financial crisis was characterized by increasing financial imbalances due to increasing risks taking and inadequate financial regulation. These financial disequilibria culminated in the crash of financial markets whose adverse effects affected emerging economies later in 2009 (sudden slump of the index in many cases). The index further suggests that the more economically and financially developed and open emerging countries (Bahrain, Croatia and Singapore, among others) have been relatively more affected by the global financial crisis.

Some of earlier periods of financial instability are also emphasized in appendix figure III.1. An example is the unstable financial environment that prevailed in Argentina in the early 2000s, and which led to successive crises later on. Between 2001 and 2003, Argentina faced a combination of banking, currency, debt, inflation crises and stock market crash. This period is captured by MFCI which falls abruptly following a considerable high level of the index in 2000 and 2001. Brazil is another good example of the prediction performances of our MFCI. In 2002, the Brazilian economy faced currency and debt crises coupled with a stock market crash. The index describes this period through its higher level earlier in the 2000s followed by an important fall in late 2002 and 2003. The downward picks in Colombia in 2007, South Korea in 2002, or Malaysia in 2001/2002 certainly emphasized the stock market crash and banking crises faced respectively by these countries during the corresponding periods (see Reinhart and Rogoff 2011, for more details on crises data).

This preliminary overview of the performances of the composite index in retrospectively and effectively underline the past important instability periods seems to highlight the relevance of our MFCI. In the next subsection, with this new and more complete measure of the financial conditions, we reassess the comparative performances of the inflation targeting regime relative to other monetary policy strategies, in terms of financial stability.

III.2. A reassessment of the effect of inflation targeting on financial instability

The preliminary investigation of the effect of inflation targeting on the financial conditions conducted in the first section was based on a somewhat parsimonious definitions of financial stability. The conclusions derived from this preliminary analysis are mixed, with the effect of inflation targeting depending on the financial instability indicator considered. The reassessment conducted in the present subsection aims to provide a more clear cut conclusion on the relative performances of targeters versus non-targeters regarding their financial stance. To this end, it relies on the more general definition of financial instability provided by the MFCI.

III.2.a. The analytical framework

The methodological approach is based on two main strategies. The first econometric approach is a panel data estimate of the effect of inflation targeting on financial instability, in the spirit of equation (1). For the second strategy, we use the propensity score matching method in order to overcome the potential self-selection bias in the adoption of inflation targeting.

Panel data analysis

The estimated equation takes the form of

$$MFCI_{it} = \gamma + \beta IT_{it} + Z_{it}^{'}\Phi + \Omega D_i + \nu_{it} \qquad (3)$$

where $MFCI_{it}$ is the index of macro-financial instability. IT_{it} is a dummy variable which takes the value of 1 for country i at time t if this country is implementing the inflation targeting monetary strategy, and 0 otherwise. Z_{it} is a vector country-specific, time-varying other factors affecting the financial conditions. D_i is the vector of the regional dummies, and v_{it} is an error term. γ, β, Φ, and Ω are model's parameters to be estimated. As for equation (1), the OLS estimation of equation (3) may be subject to endogeneity bias. We follow the same approach discussed in the first section and rely on the two stages GMM to overcome this issue.

Regarding the control variables (vector *Z*), two main groups of factors are assumed to affect the financial conditions. First, macroeconomic indicators include:

GDP growth, which is expected to be positively correlated with financial instability. As discussed earlier, the increase in risk taking and financial imbalances are often procyclical because economic agents may be too confident about the future economic perspectives, leading as a consequence to an underestimation of risks.

Log of real GDP accounts for the economic size. It is hypothesized that the largest economies are more financially developed, more integrated into the international financial system, and, accordingly more vulnerable to internal as well as external financial shocks. Consequently, the effect of economic size on financial instability is expected to be positive.

Inflation rate and *inflation volatility* are other factors which are expected to favor financial instability. Increase in inflation rate, which is usually accompanied with higher inflation volatility, increases uncertainties in the economy and blurs expectations. More generally, higher inflation and inflation volatility can be perceived as a deterioration of the economic environment which may be detrimental for financial stability. Controlling for those two variables also allows assessing more accurately the effect of inflation targeting on financial stability, by disentangling the pure impact of the inflation targeting adoption from that of inflation performances.

Exchange rate volatility increases uncertainties regarding the transactions on international markets (especially those denominated in foreign currency). In this regard, the higher the volatility of the exchange rate, the higher the currency risk faced by financial institutions, and the higher the risk of destabilization of the domestic financial system.

The second set of control variables includes some relevant indicators of countries' institutional quality:[62]

Central bank independence, following Klomp and de Hann (2009) who show that the independence of central banks lowers financial instability. Three main arguments are put

[62] Data on institutional quality and exchange rate regimes are available on an annual basis. However, these data are included in our analysis conducted in a quarterly basis because of limitations in data availability. Besides, it is unlikely that significant changes in the institutional quality or exchange rate arrangements occur within a year.

forward in this regard. First, greater independence from political pressures reduces central banks' constraints in preventing financial distress and allow central banks to act earlier and more decisively to avoid a crisis. Second, central bank independence reduces the time inconsistency problem in the financial stability policy-making (which is similar to the time inconsistency problem in the monetary policy-making). Finally, central bank independence removes the problem related to the fact that a financial crisis can be used for re-election purpose and serve as an argument in the incumbent government's campaign. These arguments suggest that a negative correlation is expected between central bank independence and financial instability.

Law and order is also expected to reduce financial instability. As argued in Klomp and de Hann (2009), law and order controls for the fact that countries lacking a sound legal system and good governance may be more prone to financial system problem because of corruption, inefficient enforcement of law, and government ineffectiveness.

Political stability is expected to lower financial instability since stable political institutions may be favorable to sound and well-functioning financial regulation institutions.

In addition to the above variables, we control for the exchange regime by introducing *fixed exchange rate regime* which is dummy variable taking the value of 1 if the exchange rate regime is fixed, and 0 otherwise. There is no clear intuition about the effect expected from this variable on financial instability, since the literature provides mixed conclusions. Earlier studies (see Rogoff et al., 2004, among others) argue in favor of a bipolar view suggesting that hard pegs and pure floating regimes are less prone to financial instability compared to intermediate regimes. A more recent empirical analysis by Ghosh et al. (2014) shows that macroeconomic and financial instability are significantly greater in less flexible regimes (including hard pegs) compared to pure floating.

We also include an indicator of *financial openness* constructed as the sum of the banking system foreign liabilities and foreign assets as a share of GDP. Financial openness can be expected to raise vulnerability to external shocks in emerging countries. In this regard, a positive effect on financial instability can be expected.

Finally, we control for *regional dummies* as described in the first section in order to account for some specific features related to these regional groups.

Propensity score matching approach (PSM)

An issue which emerges in empirical analysis aiming to compare targeting and non-targeting countries is the self-selecting bias. The choice of adopting a particular monetary policy strategy such as inflation targeting is not random and may rather depend on some countries' macroeconomic and institutional characteristics (prerequisite for a successful and credible regime). In this regard, it may be required to control for the potential self-selection bias when assessing the effect of inflation targeting on a given outcome. To overcome this issue for the purpose of our study, we rely on an impact evaluation method recently applied in the literature investigating the relative performance of inflation targeting (Vega and Winkelried, 2005; Lin and Ye, 2007; Frappa and Mésonnier, 2010): the PSM. This approach is briefly described hereunder.

We are interested in evaluating the effect of a treatment (the implementation of the inflation targeting regime) on the treated (inflation targeters) regarding a specific outcome (the financial conditions). This average treatment effect on the treated (ATT) can be estimated as follows:

$$ATT = E\left[Y_i^1 \mid T_i = 1\right] - E\left[Y_i^0 \mid T_i = 1\right] \qquad (4)$$

Where T is a dummy variable equals to 1 for an inflation targeting country. $Y_i^1 \mid T_i = 1$ is the value of outcome observed for an inflation targeter and $Y_i^0 \mid T_i = 1$ the value of this outcome if the same country had not adopted inflation targeting. But the difficulty in estimating equation (4) is that the latter value of the outcome is not observed. If the treatment is randomly distributed, the *ATT* can be derived as a simple average difference in the outcome between treated and non-treated (targeters versus non-targeters). The PSM offers an alternative approach to estimate the *ATT*. The PSM is based on the fundamental assumption that conditional to some characteristics *W*, the outcome should be independent from the treatment $(Y^0, Y^1 \perp T \mid W)$. Assuming the independence condition, equation (4) can be rewritten as follows:

$$ATT = E\left[Y_i^1 \mid T_i = 1, W_i\right] - E\left[Y_i^0 \mid T_i = 0, W_i\right] \qquad (5)$$

Where $E\left[Y_i^0 \mid T_i = 0, W_i\right]$ is observable and represents the outcome in a non-inflation targeting country with the same characteristics as the targeting country. However, this approach will be hardly applicable for a large number of covariates in *W*. A less restrictive approach would be to match treated and non-treated on the basis of a score derived as the probability of policy adoption conditional the *W* (the propensity score). The *ATT* can now be estimated using propensity scores following the above equation:

$$ATT = E\left[Y_i^1 \mid T_i = 1,\ p(W_i)\right] - E\left[Y_i^0 \mid T_i = 0,\ p(W_i)\right] \qquad (6)$$

Where $p(W_i) = \Pr(T_i = 1 \mid W_i)$ is the probability of adopting inflation targeting which can be estimated using probit or logit models. We will consider a variety of propensity scores matching methods commonly used in the literature: the nearest neighbor matching which matches treated unit to the *n* control units with the closest propensity scores; the radius matching which matches treated unit to control units with a score falling within a given radius; and the kernel matching which matches treated unit to all controls units with different weights proportional to the closeness of the control unit. For the nearest neighbor matching method, three alternatives will tested: the one-to-one nearest neighbor, the 3 nearest neighbors and the 5 nearest neighbors. The radius matching method also relies on three alternative size of the radius (*r*): *r*=0.1, *r*=0.05 and *r*= 0.02.

For the purpose of estimating the propensity scores, we use a probit model where the dependent variable is the inflation targeting dummy. Explanatory variables (*W*) are factors affecting both the adoption of inflation targeting and potentially, financial instability (the outcome). We follow the existing empirical literature and control for macroeconomic characteristics such as lagged[63] inflation rate, trade openness, real GDP per capita growth, and log of real GDP. The two first variables are expected to be negatively correlated with the probability of adopting inflation targeting, and the others positively. We also control for central bank independence and a dummy variable capturing fixed exchange rate regimes. While the central bank independence should has a positive effect on the inflation targeting adoption, the fixed exchange rate regime is expected to have negative effect. Finally, following Frappa and Mésonnier (2010), we control for both lagged long and short term

[63] Inflation rate is specified with a year lag, while lags are on a quarterly basis for the other variables.

interest rates (proxy by the government bond yields, and the money market rate, respectively). It is hard to postulate a priory on the effect of these variables. However, since monetary policy may be more aggressive in fighting inflation in targeting countries, a positive effect can be expected, at least for the short term rate.

III.2.b. Results

Results from GMM

Results from the GMM estimates are provided in table III.2. The findings show that inflation targeting is positively and significantly correlated with our index of financial conditions, suggesting that, on average, the financial sector is significantly more fragile in inflation targeting countries compared to non-targeters. This effect of the inflation targeting dummy is robust to inclusion of others control variables affecting financial instability, as well as regional dummies capturing specific regional characteristics. Regarding the coefficients associated with the other macroeconomic and institutional determinants of the financial stance, they are almost all significant with expected effects. The effect of GDP growth is positive and significant, in line with the assumption that financial imbalances are procyclical. The economic size, captured by the log of the real GDP is also positively correlated with financial stability, supporting the assumption that larger economies may be more financially vulnerable. Inflation and exchange rate volatility are also found to have a positive and significant effect on financial instability. As we argued, these two variables generate increasing uncertainties for financial institutions and for the domestic economy more generally. Therefore, they may contribute to weaken the stability of the financial system. Contrary to inflation volatility, the positive coefficient associated with inflation rate is found to be not statistically significant.

As far as the institutional variables are concerned, law and order, and political stability have negative effects on financial instability. A finding which highlights the relevance of good governance, stable political institutions, and sound legal system as factors strengthening the financial sector stability. In line with Klomp and de Hann (2009), the coefficient associated to central bank independence is negative and significant, suggesting that central bank independence reduces financial instability.

Table III.2: Effect of inflation targeting on the MFCI

	Dependent variable : MFCI (financial instability)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
IT	0.0823***	0.0637***	0.0730***	0.0741***	0.0920***	0.0917***	0.0928***	0.0806***	0.0833***	0.135***	0.0900***
	(7.331)	(5.665)	(6.712)	(6.516)	(7.043)	(6.347)	(6.426)	(5.904)	(6.190)	(9.008)	(6.286)
GDP growth	0.00921***	0.00856***	0.00725***	0.00583**	0.00559**	0.00339	0.00348	0.00553**	0.00475*	0.00578**	0.00524**
	(3.516)	(3.268)	(2.981)	(2.249)	(2.165)	(1.139)	(1.168)	(2.043)	(1.749)	(2.265)	(2.074)
Log of real GDP		0.0138***	0.0135***	0.0131***	0.0157***	0.0204***	0.0204***	0.0152***	0.0180***	0.00854**	0.00695
		(3.294)	(3.300)	(3.172)	(3.782)	(4.275)	(4.280)	(3.548)	(3.907)	(2.144)	(1.615)
Inflation volatility			0.00748***	0.00655***	0.00681***	0.00753***	0.00758***	0.00725***	0.00641***	0.00561***	0.00695***
			(5.818)	(4.373)	(4.614)	(4.517)	(4.534)	(5.433)	(4.831)	(4.140)	(5.284)
Nominal exchange rate volatility				0.235*	0.255**	0.250*	0.259**	0.289**	0.319***	0.508***	0.356***
				(1.844)	(2.021)	(1.896)	(1.973)	(2.484)	(2.679)	(4.230)	(2.936)
Fixed exchange rate regime					0.0312**	0.0308**	0.0308**	0.0222*	0.0169	0.0454***	0.0316**
					(2.529)	(2.205)	(2.205)	(1.744)	(1.387)	(3.677)	(2.461)
Inflation rate						0.00199	0.00188	0.00441	0.00449	0.00309	0.00379
						(0.560)	(0.533)	(1.453)	(1.474)	(1.078)	(1.217)
Financial openness							0.00134**				
							(1.965)				
Law and order								-0.00850*			
								(-1.825)			
Political stability									-0.00174***		
									(-3.125)		
Central bank independence										-0.161***	
										(-6.767)	
Constant	0.151***	-0.110	-0.121	-0.113	-0.190**	-0.267***	-0.269***	-0.133	-0.0952	0.0109	-0.0321
	(14.51)	(-1.341)	(-1.528)	(-1.409)	(-2.316)	(-2.805)	(-2.828)	(-1.590)	(-1.187)	(0.139)	(-0.389)
Regional dummies	-	-	-	-	-	-	-	-	-	-	yes
Observations	1,062	1,039	1,061	1,034	1,034	904	904	957	957	969	1,061
Adjusted R^2	0.0468	0.0476	0.0649	0.0625	0.0656	0.0735	0.0740	0.0702	0.0746	0.116	0.0983
F test	0	8.67e-11	0	0	0	0	0	0	0	0	0
Hansen J test	0.762	0.938	0.212	0.468	0.415	0.691	0.786	0.545	0.599	0.753	0.187

Two stages GMM estimates of equation (3). The list of instruments includes the first or the second order difference of the explanatory variables. P values of F and Hansen J tests are reported. The F test is a test of the null hypothesis that all the coefficients, except the constant, are jointly significant. The Hansen J test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses. ***, **, * indicate the statistical significance at 1, 5 and 10% restively.

Finally, the fixed exchange rate regime dummy has a positive and significant effect on financial instability. In other words, the financial sector is, on average, less stable in emerging markets with hard peg exchange rate arrangements, compared to more flexible exchange rate regimes. This conclusion is consistent with findings in Ghosh et al. (2014). Our proxy for financial openness is also positively correlated with the financial instability index. The more financially opened economies are relatively more financially vulnerable.

Results from matching

We discuss the results from the probit model before turning to the matching estimates. Three specifications are considered in order to ensure the robustness of our findings: the baseline specification corresponds to the probit estimates on the overall studied period, with the control variables listed above. In the second specification, from the baseline model, we add the regional dummies in order to control for features specific to each region, as describe in section II. Finally, from the baseline model, we restrict the sample to the period preceding the 2008/2009 global financial crisis (2000Q1 – 2008Q2).

Appendix table III.4 provides the estimates results of the probit model. The control variables are strongly significant, except for the GDP per capita growth. As expected, lagged inflation, trade openness and fixed exchange rate regime are negatively correlated with the probability of adopting inflation targeting. Central bank independence and the short term interest rate both have significant and positive effects on the probability of adopting the targeting strategy. The long term interest rate and the log of real GDP are negatively correlated with the inflation targeting dummy, although the latter effect is not robust to the three specifications considered.

Turning to the matching, prior to the estimations of the *ATT*, we make sure that the treated and control units share the same support. In other words, we would like to ensure that the estimated scores are comparable across treated and non-treated. To this end, we drop all treated units whose scores are higher than the maximum or lower than the minimum score among the non-treated units. This strategy leads us to discard 113, 95 and 86 observations respectively in three specifications considered (baseline, controlling for regional dummies and prior the global financial crisis). The results are provided in table III.3 for different matching methods, as described above.

Table III.3: Matching estimates of the effect of inflation targeting on the MFCI

	Neighbor matching			Radius matching			Kernel matching
	Nearest neighbor	3 nearest neighbors	5 nearest neighbors	r=0.1	r=0.05	r=0.02	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Baseline	0.0591*	0.0588**	0.0639**	0.0619**	0.0647***	0.0563**	0.0555**
	(1.794)	(2.173)	(2.466)	(2.511)	(2.577)	(2.180)	(2.428)
Number of observations	841	841	841	841	841	841	841
Controlling for regional dummies	0.0916***	0.0828***	0.0875***	0.0824***	0.0896***	0.0888***	0.0807***
	(3.634)	(3.546)	(4.112)	(4.421)	(4.343)	(3.975)	(3.728)
Number of observations	841	841	841	841	841	841	841
Prior to the global financial crisis	0.0594**	0.0664***	0.0717***	0.0770***	0.0717***	0.0652**	0.0617***
	(2.114)	(2.834)	(3.369)	(3.650)	(2.970)	(2.574)	(3.222)
Number of observations	640	640	640	640	640	640	640

A 0.06 fixed bandwidth and an Epanechnikov kernel are used for kernel regressions matching. T-statistics based on bootstrapped standard error are reported in parentheses (500 replications). ***, **, * indicate the statistical significance at 1, 5 and 10% restively.

The findings are in line with those of the GMM panel data estimates: inflation targeting has a positive, significant and robust effect on financial instability. Indeed, the ATT is positive and significant for all the matching methods considered, and the alternative estimations of the propensity scores. These findings evidence that on average, among emerging markets economies, inflation targeters are financially more vulnerable than countries implementing alternative monetary policy strategies.

All in all, the two first sections of this chapter assess the financial stance in a sample of emerging countries, comparing inflation targeters and non-targeters. Preliminary statistical analyses and more rigorous empirical investigations lead us to conclude that the inflation targeting strategy is associated with less stable financial conditions. An earlier study by Frappa and Mésonnier (2010) reach the same findings on a sample of industrialized economies. These conclusions seem to be supportive of criticism with regard to the inflation targeting regime, arguing that this framework is too focused on the inflation stabilization objective and discard other relevant concerns such as financial stability. In the sample considered for the purpose of this study, inflation targeters indeed perform much better in terms of inflation achievements. Both inflation rate and inflation volatility are significantly lower in targeting countries, compared to non-targeters (appendix figure III.2). Therefore, a straightforward question is whether these better performances regarding the control of inflation have been achieved at the cost of lesser concern for increasing risk in the financial sector. Having a look at the monetary policy-making, and precisely assessing the central banks' responses to both inflation and financial imbalances is one way to provide some insights regarding this issue.

IV. Central banks' reaction function and financial imbalances

In this section, the main question is whether the higher financial fragility prevailing in inflation targeting countries can be explained by lesser (or no) central banks' response to financial imbalances within the inflation targeting framework. First, the section discusses some features related to the central bank's reaction function. Second, Taylor-type rules are estimated, comparing targeters and non-targeters, as groups. Finally, we focus on targeting countries and investigates country-by-country the central banks' responses to financial instability.

IV.1. Central banks' reaction function

Relying on Taylor (1993) type rules, this subsection discusses some issues related to the central bank's reaction function. Following Taylor (1999), a simple general framework which can be used for the evaluation of monetary policy rule in a closed economy can be summarized as:

$$\begin{cases} y_t = -\beta(i_t - \pi_t - r) + u_t \\ \pi_t = \pi_{t-1} + \alpha y_{t-1} + e_t \\ i_t = g_0 + g_\pi \pi_t + g_y y_t \end{cases} \tag{7}$$

where y is the percentage deviation of real GDP from its potential level, i is the short term nominal interest rate, *i.e.* the monetary policy instrument, π is the inflation rate, r the long-run equilibrium real interest rate, β and α are the slope parameters, and u and e are stochastic disturbance terms. The last equation of the above system describes the central bank's reaction function. Central bank sets the interest rate in response to current inflation and output gap, given the parameters g_π and g_y.

Subsequent theoretical and empirical studies point the relevance to account for some inertia in the central bank's policy rate setting, reflecting the desire to smooth the changes in interest rate. As argued by Woodford (2001), for monetary policy, it is generally optimal to respond "inertially" to fluctuations in the target variables and/or their determinants. One of the economic rationales behind this inertia is related to the fact that the effect of monetary policy is highly dependent on market participants' expectations about the future policy. In this respect, smoothing the changes in policy rate will improve its expected effect on the long-term rate since the private sector will anticipate a continuously increase of the short term rate. When there are some uncertainties about model's parameters (as it might be the case particularly in emerging and developing countries), the interest rate smoothing can help reducing policy mistakes. Another concern about the interest rate setting is its effect on the financial sector. A sudden large increase in interest rate could be subject to financial risks if it exposes market participants to capital losses, particularly because they have limited capacity to hedge interest rate risk (Mohanty and Klau, 2004).

In small open economies, exchange rate fluctuations are a particular concern for monetary policy. Exchange rate fluctuations may generate important costs for highly dollarized economies, where there are currency and maturity mismatches of assets. Emerging countries are, by more than high income economies, vulnerable to external shocks affecting the exchange rate. Besides the above mentioned effect through dollarization, exchange rate fluctuations could also be detrimental as a pass-through for inflation, since many emerging markets are net importers and thus exposed to imported inflation. Exchange rate fluctuations also affect the financial system; first through the financial institutions' foreign currency denominated liabilities/assets, but also through speculative attacks on the domestic currency and increasing volatility of external capital flows. All these arguments put together underline the so called "fear of floating" characterizing emerging economies, and rationalize the concern for exchange rate in the monetary policy setting.[64]

Taking into account the need for interest rate smoothing and concerns for exchange rate fluctuations, the central bank's reaction in equation (7) can be rewritten as:

$$i_t = \delta_0 + \delta_1 i_{t-1} + \delta_2 (\pi_t - \pi_t^*) + \delta_3 y_t + \delta_4 x_t + \varepsilon_t \qquad (8)$$

where i_t is the short term nominal interest rate, π_t and π^* are the observed and targeted inflation rate respectively, y_t is the output gap, x_t is the nominal exchange rate gap, and ε_t an error term. The term i_{t-1} is introduced to account for interest rates smoothing as it is now common in the empirical literature (see Clarida et al., 1998, among others). Theoretically, the parameters δ_0, δ_1, δ_2, δ_3 are expected to be positive, and δ_4 negative.

In equation (8), the so called "Taylor principle" will hold if the long-term effect of inflation gap is greater than 1, i.e. $\delta_2/(1- \delta_1) > 1$. The Taylor principle requires that the central bank raises its interest rate by more than the increase in inflation, so that the real interest rate increases until inflation returns to the targeted level. As pointed by Fendel et al. (2011), although sufficient, the Taylor principle is not a necessary condition for the effectiveness of interest rate settings. As soon as other factors such as output gap or exchange rate deviations are included in the central bank's reaction function, the necessary condition should also

[64] The last chapter is especially devoted to discuss this issue.

include their associated effects. For more discussion on the relevance of the Taylor principle in emerging countries inflation targeters, see Teles and Zaidan (2010).

Another feature of the specification described in equation (8) is the central bank's reaction to current deviations of inflation and output. "Forward looking" reaction function, in which central banks set the short term interest rate in response to expected inflation and output gaps, is an alternative specification used in the empirical literature, especially for industrialized economies (Clarida et al., 1998, among others). However, it can be argued that a "current" specification for emerging countries is not misleading for a number of reasons. First, the macroeconomic models used by central banks in emerging economies are certainly less developed and reliable compared to high income countries; therefore it is questionable whether the monetary policy framework is actually forward looking. Second, investigating the conduct of monetary policy in emerging countries, Moura and de Carvalho (2010) use 16 alternative specifications of central banks' reaction function. Their findings suggest that among the 7 sample countries,[65] only 2 seem to implement a forward looking strategy. Third, a forward looking specification requires data on expectations used by central banks. It is common in the empirical literature to rely on private sector expectations provided by the Consensus Forecast database, for example. But there is no evidence that these are data actually used by central banks in their monetary policy-making.[66] Finally, it should be noteworthy that the aim of our empirical tests is not to describe the conduct of monetary policy per se. We rather focus on investigating whether the central bank's interest rate setting responds to financial imbalances. Nevertheless, "current" specifications as ours are also common in the literature describing central banks' reaction function in emerging countries (Mohanty and Klau, 2004; Moura and de Carvalho, 2010; Aizenman et al., 2011, among others).

To account for a potential reaction of the monetary policy instrument to financial stability, the specification in equation (8) is augmented with a financial instability indicator as follows:

$$i_t = \delta_0 + \delta_1 i_{t-1} + \delta_2(\pi_t - \pi_t^*) + \delta_3 y_t + \delta_4 x_t + \delta_5 fc_t + \varepsilon_t \qquad (9)$$

[65] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela.

[66] Besides, unfortunately, these data on private sector expectations are much less available for emerging countries.

where *fc* stands for a financial condition indicator. δ_5 is expected to be positive, suggesting an increase in the short-term interest rate in response to higher financial imbalances; a strategy referred to as the "leaning against the wind" policy in the recent literature, as discussed in chapters I and IV.

An objection can be raised regarding the estimation of equation (9) and the interpretation derived when δ_5 is found to be positive and significant. Following our argumentation, we will conclude that the central bank responds to financial instability, in addition to its traditional macroeconomic concerns. But, another relevant interpretation of such a result may be to see the central bank's response to financial variables as a mean to improve its strategy for better achievements regarding is primary objective, namely inflation stabilization. For example, a central bank may raise the short term interest rate in response to increase in changes in credit to GDP or credit growth, because the later has consequences in terms of increasing inflation, but not necessarily because of financial stability concerns. Alternatively, if δ_5 is non-significant in equation (9), this may not strictly suggest that the central bank is not concerned with financial instability. Instead, considering inflation stabilization as the primary objective, the central bank may be sensitive to other issues such as financial imbalances only to the extent that this primary objective is achieved. To deal with these possible considerations, we rely on a specification of the Taylor-type rule which accounts for asymmetric response of the central bank to financial instability. This specification takes the form of:

$$i_t = \delta_0 + \delta_1 i_{t-1} + \delta_2(\pi_t - \pi_t^*) + \delta_3 y_t + \delta_4 x_t + \delta_5 fc_t + D * \delta_6 fc_t + \varepsilon_t \qquad (10)$$

where *D* is a dummy variable which takes the value of 1 when inflation rate is equal or below the target (*i.e.* $\pi \leq \pi^*$), and 0 otherwise. Following equation (10), the short term rate response to financial instability is given by:

$$\frac{\partial i_t}{\partial fc_t} = \delta_5 + D * \delta_6$$

When inflation is above its targeted level, *i.e.* when $\pi > \pi^*$, *D* is equal to 0 and equation (9) holds. Conversely, when the central bank's inflation objective is achieved, *i.e.* when $\pi \leq \pi^*$, the total effect of *fc* is equal to ($\delta_5+\delta_6$). Note that this total effect can be either positive, zero or even negative. Indeed, if the central bank is primarily (or only) concerned with inflation, δ_6

can be negative when D = 1. The central bank may ease the monetary policy stance by lowering the interest rate in order to support or foster the economic activity through a lower cost of loan for example, when there is no inflation pressure. In this later case, if δ_5 if not significant, or is lower in magnitude than δ_6, the overall central banks response is negative (monetary policy easing). But if (δ_5+δ_6) is significantly positive, we can conclude that the central bank is concerned with financial issues, because it strengthens the monetary policy stance in response financial imbalances, even when its inflation objective is achieved; or alternatively, that the central bank pays attention to financial stability when its primary goal is met (this interpretation is particularly relevant if no response is found when estimating equation (9) in a first stage).

Regarding the econometric approach, we follow Clarida et al. (1998) and use the two-steps GMM technic to estimate the model's parameters. The instruments list includes the first or the second order differences of the right hand side variables of the estimated equation plus the log of the commodity price index. As discussed earlier, the differentiated variables provide better exogeneity conditions than the lagged variables. Besides, given the relatively short studied period, this approach which requires a lower number of instruments may be more suitable because it allows keeping higher number observations for regressions.

IV.2. Central banks' response to financial instability: targeters vs non-targeters

In this subsection, we confront targeting and non-targeting countries regarding their responses to financial imbalances. Taylor-type rules are estimated for each of the two groups separately, using panel data analysis (panel data analysis of central banks' reaction functions in emerging countries has been investigated for example in Aizenman and Hutchison, 2011). Unlike targeting countries, most of non-inflation targeters do not set an official inflation target. Consequently, for non-targeters, the inflation gap is the difference between actual inflation rate and its long term trend generated with the HP filter. Also, as it is common practice in the empirical literature, the output gap and the exchange rate gap are deviations of output and nominal effective exchange rate from their respective trend, derived from the HP filter. The short term interest rate is proxied by the money market rate.

Reconsidering equations (9) and (10), *fc* is replaced by the MFCI, our broad measure of financial instability. Besides, we run three alternative specifications of these equations corresponding to three assumptions regarding the timing of central banks' responses:

- A *current* model, where we investigate whether central banks are currently responsive to financial instability. The short term interest rate and the MFCI are both set at time *t*.
- A *backward* looking model, where it is assumed that central banks can respond to financial imbalances with a lag (which may be required to effectively assess the financial conditions). Here, the MFCI enters the equation with a year lag (*t-4*).
- And a *forward* looking model, where it is hypothesized that central banks are concerned with expected imbalances in the financial sector. The MFCI is then set a year ahead (*t+4*).[67]

Table III.4 provides the results for both the standard (equation (8)) and the augmented (equations (9) and (10)) central banks' reaction functions. Results from the standard specification show that in targeting and non-targeting countries, the short term interest rate responds to inflation deviations. However, the central banks reaction seems to be more aggressive in targeting countries (δ_2 is higher in the targeting central banks' reaction function). In the inflation targeting group, the response to output gap and exchange rate deviations are also in line with the theoretical assumptions: restrictive monetary policy in response to increase in the output gap, and decreasing short term interest rate in reaction to exchange rate deviations from the equilibrium. Regarding non-targeting countries, there is no response to the output gap, while the short term interest rate responds positively to the exchange rate gap.

As regards the financial stability concern, equation (9) is estimated following the three hypotheses discussed above. The results show that δ_5 is significantly positive only for the inflation targeting group in the *current* model specification. This finding suggests that, within inflation targeting countries, central banks are concerned with current financial imbalances and respond to financial instability by tightening the policy stance. This reaction seems not to modify the central banks behavior regarding their other traditional objectives. Indeed, the

[67] This is a quite strong hypothesis since we are assuming perfect expectations. However, we make this assumption for simplicity and we presume that the potential expectations errors may be included in the error term.

responses to the other arguments of the reaction function remain strongly significant, as in the standard model

Table III.4: Central bank reaction functions (targeters vs non-targeters)

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_0	Obs.	R^2	Ftest	Hansen J test
		Standard central bank reaction function [equation (8)]										
Iters		0.930***	0.119***	0.0426***	-0.0165**			0.248***	481	0.958	0	0.114
		(62.06)	(5.470)	(4.474)	(-2.195)			(2.916)				
Non-Iters		0.806***	0.0995*	0.000706	0.126***			0.940***	546	0.646	0	0.294
		(14.58)	(1.735)	(0.0373)	(3.464)			(3.580)				
		Linear central bank reaction function [equation (9)]										
Iters	*current*	0.918***	0.138***	0.0255**	-0.032***	0.509**		0.280**	351	0.964	0	0.488
		(61.77)	(5.430)	(2.545)	(-4.169)	(2.298)		(2.507)				
	backward	0.928***	0.143***	0.0229**	-0.031***	0.0406		0.333***	342	0.966	0	0.648
		(64.98)	(5.559)	(2.361)	(-4.029)	(0.190)		(2.851)				
	forward	0.922***	0.137***	0.0258***	-0.034***	0.315		0.300**	347	0.965	0	0.722
		(62.19)	(5.811)	(2.720)	(-4.087)	(1.479)		(2.511)				
Non-Iters	*current*	0.849***	0.127**	0.00849	0.112***	0.693		0.699***	396	0.767	0	0.835
		(17.39)	(2.460)	(0.603)	(3.983)	(0.730)		(2.847)				
	backward	0.859***	0.107**	0.0117	0.116***	0.733		0.650**	369	0.692	0	0.540
		(12.17)	(2.085)	(0.641)	(2.784)	(0.563)		(2.062)				
	forward	0.773***	0.0558	0.0137	0.129***	1.316		0.908***	408	0.750	0	0.506
		(11.58)	(0.972)	(0.761)	(5.533)	(1.270)		(3.202)				
		Non-linear central bank reaction function [equation (10)]										
Iters	*current*	0.924***	0.111***	0.0414***	-0.0140*	0.577**	-0.188	0.166	481	0.958	0	0.200
		(63.85)	(4.452)	(4.317)	(-1.930)	(2.177)	(-0.735)	(1.590)				
	backward	0.943***	0.108***	0.0369***	-0.00784	-0.0873	0.505***	0.161	440	0.960	0	0.371
		(67.64)	(5.402)	(3.837)	(-1.098)	(-0.369)	(2.731)	(1.483)				
	forward	0.928***	0.115***	0.0445***	-0.0178**	0.505*	-0.418*	0.165	425	0.957	0	0.453
		(62.97)	(5.386)	(4.245)	(-2.317)	(1.951)	(-1.647)	(1.387)				
Non-Iters	*current*	0.818***	0.143**	0.00564	0.113***	0.475	-0.144	0.859***	526	0.712	0	0.380
		(18.28)	(2.237)	(0.363)	(4.119)	(0.318)	(-0.0832)	(2.756)				
	backward	0.874***	0.113**	-0.00880	0.132***	0.309	-0.0320	0.595	484	0.659	0	0.326
		(13.94)	(2.036)	(-0.491)	(2.663)	(0.173)	(-0.0226)	(1.561)				
	forward	0.810***	0.102*	0.00182	0.113***	0.846	1.307	0.704**	484	0.686	0	0.353
		(12.26)	(1.767)	(0.110)	(3.821)	(0.865)	(0.856)	(2.296)				

Two stages GMM estimates of equations (8), (9), (10). The list of instruments includes the second order difference of the explanatory variables and the log of the commodity price index. P values of F test and Hansen J test are reported. The F test is a test of the null hypothesis that all the coefficients, except the constant, are jointly significant. The Hansen J test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses.***, **, * indicate the statistical significance at 1, 5 and 10% restively.

The non-linear specification of the central banks' reaction function (equation 10) also provides interesting results. First, note that there are no responses from the non-targeting central banks to financial instability. For targeters, the central banks' response to financial instability in the *current* model remains relevant even when the inflation objective is achieved, suggesting that the financial indicator is not an intermediated objective for inflation stabilization. The *backward* model estimates shows that δ_6 is significantly positive, implying that central banks respond to past observed financial imbalances only when their inflation goal has been met (recall that there were no response with the linear specification). As we discussed earlier, if the primary or more traditional objectives are met, central banks may have more room to deal with other concerns. As regard the *forward* looking model, δ_5 is positive and significant while δ_6 is also significant but negative. Following our theoretical argumentation, since (δ_5+δ_6) is positive, we can concludes that in inflation targeting countries, central banks are also concerned with expected financial fragility and respond preventively to avoid financial imbalances in subsequent periods.

Following the comparative analysis of the financial stance in targeting versus non-targeting countries in the two first sections, this subsection aims at investigating the extent to which the monetary policy making in those groups may be guided by concerns about financial instability, in addition to the more standard objectives. Our findings suggest that (on average) central banks in targeting countries respond to financial imbalances in their interest rate setting. However, this reaction is not totally independent from achievements regarding their primary inflation stabilization objective. Precisely, while those central banks seem to worry about "current" imbalances in the financial sector regardless of realizations in terms of inflation, their response to past and expected financial issues seems to be conditional to the achievement of the inflation stabilization goal.

The above conclusions are general and based on a sample of targeting and non-targeting countries whose central banks may behave differently. Given that this study is particularly interested in investigating the extent to which financial stability may be discarded in the inflation targeting framework, in the next subsection we focus on countries implementing this monetary policy strategy and assess country by country their central banks' reaction function.

IV.3. Inflation targeting central banks' response to financial instability

Prior the discussion of the response to financial instability, standard Taylor rules (equation 8) are estimated for each targeting country central bank. Appendix table III.5 presents the results. Except for Korea, the short term interest rate response to inflation deviations from the target is significantly positive, highlighting the concern for inflation stabilization in targeting central banks. The economic cycle's stabilization issue, captured by the police instrument's reaction to the output gap, is also relevant for almost all monetary authorities among the inflation targeters (exceptions are Philippines, South Africa and Thailand). Regarding the concern for exchange rate misalignments, the findings suggest that most of the central banks attempt to stabilize the nominal effective exchange rate, through easing monetary policy in the face of exchange rate appreciation. Overall, these results from standard Taylor rule estimates are in line with the theoretical assumptions and previous findings in the literature.

Turning to our main purpose which is central banks' responses to financial imbalances, we proceed in two steps. First, as a preliminary analysis, we investigate the central banks' reaction to some common indicators of financial risks (discussed in in section II). Second, we rely on our composite index of the financial conditions to get a more complete measurement of financial instability.

Equation (9) is estimated for each of the 13 inflation targeters and *fc* is replaced successively by the *changes in credit to GDP* ratio, the *changes in the share price index*, and the *changes in capital flows*. Central banks are expected to respond to these changes by tightening monetary policies. Higher short term interest rates can be expected to dampen increasing loan supply by affecting the cost of credit. In the same line of arguments, monetary policy easing can feed rapid growth in share prices (higher demand) while restrictive policy can be expected to play in the opposite way. The capital flows, the ratio of banks foreign assets to total assets, can also be affected by the short term interest rate, as higher interest rates may increase the domestic assets' return, thereby reducing the incentive to search for yields by acquiring foreign (and potentially more risky) assets.

Results provided in appendix table III.6 show that central banks responses to these indicators are not uniform across countries. In Chile, Colombia, Korea and South Africa, the monetary authorities seem be particularly concerned with developments on the credit market. Indeed, central banks in these countries tighten the monetary policy stance in response to an increase in the change in the credit to GDP ratio. The stock market seems to be particularly scrutinized in Israel and the Philippines, as central banks adjust their policy rate in reaction to changes in the share price index. Regarding the exposure to external financial risks, 3 out of the 13 targeters directly respond by raising the short term interest rate in the face of increasing foreign assets (relative to total assets): Korea, the Philippines and South Africa.

This preliminary analysis with some basic indicators of the financial conditions is instructive in the sense that it highlights the complexity in defining financial instability. The findings suggest that countries may be concerned with various aspects of the risk in the financial sector. Furthermore, it can be argued that central banks' responses may rest on a more complete assessment of the financial conditions, which includes various types of risks, and not necessarily on an indicator capturing a specific source of risk. Our composite index should provide such a more rigorous and accurate investigation of the central reaction to changes in the financial stance.

Table III.5 provides estimates results of augmented central banks' reaction functions, with the composite index of financial instability. Equation (9), where *fc* is the MFCI, is estimated following the three assumptions discussed earlier. Considering the *current* specification of the reaction function, five countries among targeters seem be explicitly concerned with financial stability. In Brazil, Czech Republic, Mexico, Peru and South Africa, the central bank responds to "current" financial imbalances through tightening monetary policy. According to the findings from the *backward* specification, the Czech, the Peruvian and the South African central banks also react to past observed financial disequilibria when setting the policy instrument. In the case of Czech Republic and Peru, the response to current financial developments is stronger (in magnitude and significance) than the backward reaction; suggesting that the *current* model better captures the way the Czech and the Peruvian central banks are concerned with financial instability. For South Africa, the *backward* and the *current* specifications do not exhibit very different results. The significance level of the coefficient associated with MFCI is the same, although the magnitude is slightly higher in the *backward* model. Only two central banks seem to be concerned with expected financial imbalances. In Colombia and Poland, the reaction to financial instability is forward looking, as their central banks respond pre-emptively to financial imbalances.

Table III.5: Linear central banks reaction functions (inflation targeters)

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_0	Obs.	R^2	Ftest	Hansen J test
Brazil	*current*	0.690***	0.261***	0.0744**	0.00170	4.614***	1.571***	41	0.930	0	0.257
		(9.789)	(4.503)	(2.425)	(0.159)	(3.395)	(2.956)				
	backward	0.861***	0.220***	0.121**	-0.0201	0.504	1.389**	39	0.890	0	0.133
		(16.39)	(2.708)	(2.147)	(-1.201)	(0.291)	(1.972)				
	forward	0.815***	0.257***	0.0781	-0.0381**	1.125	1.747*	38	0.872	0	0.231
		(10.96)	(2.869)	(1.558)	(-2.391)	(1.171)	(1.946)				
Chile	*current*	0.444***	0.346***	0.0829***	-0.00433	-0.0785	2.046***	42	0.741	0	0.146
		(4.968)	(5.183)	(2.657)	(-0.158)	(-0.0368)	(4.913)				
	backward	0.585***	0.305***	0.0754**	0.0112	0.162	1.570***	39	0.823	0	0.269
		(7.196)	(4.547)	(2.436)	(0.527)	(0.0545)	(3.629)				
	forward	0.419***	0.387***	0.0822***	-0.0187	-4.043***	2.519***	37	0.688	0	0.382
		(3.168)	(4.320)	(2.793)	(-0.707)	(-2.896)	(5.234)				
Colombia	*current*	0.802***	0.246***	0.105*	-0.00904	-0.486	1.239***	41	0.922	0	0.719
		(13.31)	(2.709)	(1.901)	(-0.544)	(-0.253)	(3.190)				
	backward	0.784***	0.277***	0.0796	-0.0102	-0.970	1.429***	39	0.908	0	0.467
		(12.21)	(2.780)	(1.315)	(-0.594)	(-0.688)	(2.795)				
	forward	0.663***	0.254***	0.184***	-0.000889	1.918*	1.856***	37	0.904	0	0.750
		(10.91)	(3.558)	(3.741)	(-0.0735)	(1.825)	(4.793)				
Czech Rep.	*current*	0.784***	0.0971***	0.0458***	-0.0344***	1.288***	0.426***	41	0.950	0	0.166
		(17.11)	(5.189)	(4.549)	(-3.433)	(3.929)	(3.715)				
	backward	0.722***	0.0973***	0.0322**	-0.00695	0.956*	0.584***	37	0.916	0	0.383
		(11.32)	(3.705)	(2.464)	(-0.480)	(1.669)	(3.944)				
	forward	0.807***	0.0872***	0.0296***	-0.0319**	0.370	0.509***	37	0.934	0	0.290
		(11.89)	(4.415)	(2.625)	(-2.568)	(0.582)	(3.352)				
Hungary	*current*	0.823***	0.104*	0.0701***	-0.0751**	1.236	1.131*	37	0.727	0	0.255
		(9.795)	(1.694)	(3.236)	(-2.098)	(0.581)	(1.936)				
	backward	0.810***	0.0937	0.0495**	-0.0764*	1.275	1.255**	35	0.738	0	0.204
		(9.991)	(1.103)	(1.989)	(-1.822)	(0.686)	(2.350)				
	forward	0.816***	0.189***	0.0758**	-0.117***	1.740	1.015	30	0.740	0	0.242
		(10.00)	(3.415)	(2.386)	(-2.867)	(0.958)	(1.636)				
Israel	*current*	0.931***	0.171***	0.0806**	-0.0437*	0.636	0.173	42	0.905	0	0.523
		(27.22)	(3.002)	(2.479)	(-1.754)	(0.738)	(1.052)				
	backward	0.923***	0.174***	0.0636*	-0.0445*	0.370	0.209	39	0.881	0	0.547
		(29.18)	(3.628)	(1.666)	(-1.918)	(0.532)	(1.366)				
	forward	0.913***	0.0923**	0.0700**	-0.0382	0.600	0.164	38	0.880	0	0.386
		(27.81)	(2.436)	(2.003)	(-1.303)	(0.528)	(0.957)				
Korea Rep.	*current*	0.792***	0.120*	0.0176**	0.0406***	-0.798***	1.159***	39	0.936	0	0.101
		(23.69)	(1.870)	(2.286)	(5.789)	(-3.500)	(6.431)				
	backward	0.857***	0.0595	0.0151**	0.0336***	0.147	0.427	39	0.923	0	0.117
		(10.71)	(0.754)	(2.383)	(3.363)	(0.297)	(0.798)				
	forward	0.744***	0.169***	0.0126*	0.0454***	0.0290	0.926***	35	0.911	0	0.315
		(16.28)	(3.073)	(1.717)	(7.382)	(0.125)	(5.053)				

Table III.5

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_0	Obs.	R^2	Ftest	Hansen J test
Mexico	*current*	0.802***	0.207	0.301***	-0.0640**	2.977**	0.429	42	0.920	0	0.193
		(12.61)	(1.330)	(3.925)	(-2.002)	(2.477)	(1.089)				
	backward	0.731***	0.140	0.292***	-0.0593*	1.209	1.365***	39	0.829	0	0.115
		(11.74)	(0.989)	(3.230)	(-1.903)	(0.749)	(3.121)				
	forward	0.840***	0.237	0.306***	-0.0645*	0.410	0.692	38	0.905	0	0.254
		(11.50)	(1.297)	(3.322)	(-1.790)	(0.385)	(1.296)				
Peru	*current*	0.862***	0.159**	0.0337**	0.0569	1.056**	0.145	35	0.635	0	0.243
		(10.81)	(2.408)	(2.236)	(1.300)	(2.181)	(0.485)				
	backward	0.829***	0.155**	0.0351**	0.00743	0.640*	0.452**	35	0.647	0	0.442
		(10.69)	(2.507)	(2.575)	(0.212)	(1.879)	(2.085)				
	forward	0.866***	0.126**	0.0476**	-0.0279	0.157	0.407	31	0.578	0	0.394
		(9.300)	(1.976)	(2.506)	(-0.705)	(0.248)	(0.742)				
Philippines	*current*	0.974***	0.0516**	0.00418	-0.0544***	0.144	-0.0721	35	0.867	0	0.340
		(18.28)	(2.213)	(0.407)	(-4.989)	(0.416)	(-0.210)				
	backward	0.987***	0.0542**	0.00599	-0.0575***	0.182	-0.184	35	0.869	0	0.317
		(18.43)	(2.204)	(0.609)	(-4.037)	(0.425)	(-0.500)				
	forward	1.122***	0.0565*	0.00547	-0.0668***	0.504	-1.241**	31	0.821	0	0.411
		(12.96)	(1.749)	(0.504)	(-5.670)	(1.306)	(-2.030)				
Poland	*current*	0.911***	0.290***	0.0244*	-0.0115	1.646	0.143	42	0.981	0	0.438
		(33.62)	(8.078)	(1.748)	(-1.212)	(1.324)	(0.848)				
	backward	0.856***	0.165***	0.0113	0.0125	0.435	0.544***	39	0.982	0	0.186
		(39.44)	(3.299)	(1.284)	(0.953)	(0.400)	(4.022)				
	forward	0.910***	0.305***	0.0380**	-0.0120	2.038*	0.0592	38	0.980	0	0.419
		(38.53)	(9.032)	(2.472)	(-1.334)	(1.940)	(0.310)				
South Africa	*current*	0.690***	0.179***	0.0337	-0.0227***	2.484**	2.172***	41	0.932	0	0.542
		(12.76)	(4.148)	(0.509)	(-3.209)	(2.487)	(4.826)				
	backward	0.632***	0.204***	0.0974	-0.00138	3.032**	2.596***	39	0.935	0	0.509
		(13.76)	(4.675)	(1.261)	(-0.102)	(2.278)	(7.269)				
	forward	0.645***	0.143***	0.142**	-0.0179***	0.966	2.869***	37	0.929	0	0.445
		(9.874)	(3.834)	(2.207)	(-2.601)	(1.464)	(5.090)				
Thailand	*current*	0.969***	0.116***	-0.00436	-0.0391**	0.675	-0.294	41	0.934	0	0.622
		(23.55)	(4.863)	(-0.365)	(-2.051)	(1.072)	(-1.128)				
	backward	0.969***	0.107***	0.00516	-0.0500**	0.359	-0.158	39	0.935	0	0.634
		(22.65)	(4.862)	(0.365)	(-2.497)	(0.605)	(-0.593)				
	forward	1.022***	0.0928***	-0.00385	-0.0690***	0.456	-0.318	37	0.927	0	0.464
		(19.50)	(3.235)	(-0.293)	(-3.004)	(0.527)	(-0.888)				

Two stages GMM estimates of equations (9). The list of instruments includes the second order difference of the explanatory variables and the log of the commodity price index. P values of F and Hansen J tests are reported. The F test is a test of the null hypothesis that all the coefficients, except the constant, are jointly significant. The Hansen J test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses.***, **, * indicate the statistical significance at 1, 5 and 10% restively.

Overall, 7 of the 13 emerging countries inflation targeters in our sample respond directly to financial imbalances in their short term interest rate setting, either currently, with a lag or preventively. Following the caution raised regarding the interpretation of the estimates results from equation (9), we now consider a specification allowing non-linear reactions of the central banks (equation (10)).

Equation (10) is estimated, again, considering the three assumptions regarding the timing of central banks' responses. Results are provided in table III.6. The findings from the *current* specification are broadly in line with conclusions derived from the estimation of equation (9). The Brazilian, Czech, Mexican and South African central banks respond to "current" developments in the financial sector. The strength of these responses is very similar to those obtained when discarding potential non-linearities in the central bank's reaction function. This evidence suggests that these central banks are especially concerned with financial issues (when setting their policy instrument), independently from their inflation stabilization objective. Besides, in Brazil, contrary to the finding with the linear reaction function, the central bank also seems to be concerned with expected financial imbalances and react preventively to financial instability when the level of inflation is expected to be below the target. Furthermore, the later reaction is stronger than the response to current financial imbalances, emphasizing the fact that, when inflation is under control, the central bank is more prompt to act for the purpose of limiting future financial imbalances.

While a reaction from the Peruvian central bank to financial imbalances has been found with a linear specification of its reaction function, this effect vanishes when controlling for a possible asymmetry in the central bank's response. A possible interpretation of the later result is that in Peru, financial variables are scrutinized by the monetary authorities as a mean to improve the control of inflation. As a consequence, as soon as the inflation objective is met, the monetary authority does not react directly to changes in the financial conditions. For Hungary and Korea, the overall "current" effect of the financial conditions index is negative, stressing an accommodative monetary policy in these countries, when there is no concern regarding inflation. However, the central bank of Hungary is found to respond adversely to increase in expected financial imbalances, but once its inflation stabilization objective is met.

Results from the *backward* and the *forward* models evidence the robustness of the central banks' reaction to financial imbalances in Colombia and Poland. Especially, as with the linear specification of the central banks reaction function, findings from the *forward* model show that the response to financial instability is significant even when the inflation objective is achieved. In addition, when looking at results from the *backward* model, the Colombian and the Polish central banks seem to react to past financial imbalances, but only when inflation rate is not above its target. Another striking result regards the Bank of Israel for which δ_6 is positive and significant only in the *backward* model, and when allowing asymmetric central bank's reactions. In other words, the Bank of Israel is concerned with financial instability and responds to past observed financial imbalances only if inflation is below its target.

To sum up, the central bank of Brazil raises the short term interest rate in response "current" financial imbalances. It responds more strongly to prevent financial instability, by reacting to expected disequilibria in the financial sector, but only as long as inflation remains under control. In Colombia, the central bank's response to financial instability seems to be essentially backward looking, and takes place when inflation has been stabilized. For the Czech Republic and Mexico, the best description of the central bank's response to financial instability is a contemporaneous reaction of the policy instrument to changes in the financial conditions. In Hungary and Israel, the response of central banks to financial imbalances is conditional on their achievements regarding their primary inflation objective. While the response is forward looking in Hungary, it is backward looking for the Bank of Israel. The central bank of Poland implements a restrictive monetary policy in prevention to expected financial imbalances. This reaction of the policy instruments to financial instability remains relevant when there is no concern about expected inflation. Finally, the central bank of South Africa seems to be concern with both "current" and past developments in the financial sector. However, the response to past financial imbalances is stronger, suggesting that it is a better characterization of the South African central bank's reaction the financial instability.

The assessment of the country-by-country central bank's reaction function supports the conclusion derived from the panel data analysis which suggests that inflation targeters are concerned with financial instability issues in their interest rate setting. Indeed, we find that for 8 out of the 13 inflation targeting countries in our sample, central banks respond to changes in the financial stance, although the timing of their reaction may be different.

Table III.6: Non-linear central banks reaction functions (inflation targeters)

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_0	Obs.	R^2	Ftest	Hansen J test
Brazil	*current*	0.685***	0.257***	0.072**	0.00280	4.738***	-0.0856	1.599***	41	0.93	0	0.239
		(8.212)	(3.634)	(2.387)	(0.265)	(3.144)	(-0.118)	(2.980)				
	backward	0.860***	0.285***	0.111**	-0.0112	-0.745	-0.310	2.027**	39	0.89	0	0.114
		(16.20)	(4.264)	(2.001)	(-0.729)	(-0.454)	(-0.551)	(2.562)				
	forward	0.562***	0.403***	0.0168	-0.032***	4.654***	4.476***	2.961***	38	0.91	0	0.184
		(6.279)	(4.784)	(0.307)	(-2.774)	(3.771)	(3.749)	(4.472)				
Chile	*current*	0.427***	0.335***	0.083***	-0.00691	2.596	-2.805	2.054***	42	0.73	0	0.138
		(4.729)	(4.651)	(2.658)	(-0.241)	(0.472)	(-0.629)	(4.894)				
	backward	0.637***	0.260***	0.09***	0.0149	1.375	-0.547	1.343***	39	0.82	0	0.112
		(7.769)	(3.595)	(2.906)	(0.662)	(0.300)	(-0.159)	(3.128)				
	forward	0.425***	0.392***	0.091***	-0.0179	-7.114*	2.844	2.610***	37	0.68	0	0.458
		(3.221)	(4.514)	(2.928)	(-0.687)	(-1.744)	(0.788)	(5.069)				
Colombia	*current*	0.820***	0.317***	0.0748	-0.00789	-0.994	1.463	1.102**	41	0.92	0	0.712
		(12.77)	(3.059)	(1.351)	(-0.482)	(-0.526)	(0.919)	(2.543)				
	backward	0.819***	0.281***	0.0384	-0.0176	-1.783	2.226***	1.298***	39	0.91	0	0.620
		(12.18)	(3.151)	(0.642)	(-1.118)	(-1.564)	(2.982)	(2.613)				
	forward	0.645***	0.273***	0.181***	0.00323	2.090**	-1.059*	2.022***	37	0.91	0	0.625
		(11.34)	(4.696)	(3.824)	(0.408)	(2.096)	(-1.935)	(5.705)				
Czech Rep.	*current*	0.789***	0.083***	0.037***	-0.029***	1.484***	-0.556	0.430***	41	0.95	0	0.232
		(17.13)	(3.815)	(3.252)	(-2.786)	(3.942)	(-1.145)	(3.730)				
	backward	0.779***	0.062***	0.035***	-0.0083	-0.120	0.938***	0.470***	37	0.92	0	0.228
		(10.68)	(3.445)	(3.007)	(-0.585)	(-0.265)	(2.754)	(2.788)				
	forward	0.806***	0.0950***	0.031***	-0.0279**	0.922	-0.527	0.499***	37	0.93	0	0.187
		(11.85)	(5.500)	(2.909)	(-2.232)	(0.781)	(-0.548)	(3.432)				
Hungary	*current*	0.818***	-0.0192	0.070***	-0.0427	0.166	-11.9***	1.613***	36	0.74	0	0.459
		(10.45)	(-0.244)	(3.083)	(-1.178)	(0.0857)	(-3.655)	(2.796)				
	backward	0.805***	0.102	0.0465*	-0.0700	1.547	0.283	1.192	35	0.73	0	0.197
		(8.545)	(1.231)	(1.801)	(-1.428)	(0.874)	(0.0719)	(1.578)				
	forward	0.765***	0.142***	0.080***	-0.108***	2.604	22.58***	1.418**	30	0.78	0	0.231
		(9.313)	(3.184)	(2.585)	(-2.841)	(1.329)	(5.646)	(2.400)				
Israel	*current*	0.915***	0.187***	0.0721*	-0.0472**	-0.0201	1.040	0.238	42	0.90	0	0.494
		(21.52)	(3.913)	(1.938)	(-2.052)	(-0.0150)	(0.556)	(1.307)				
	backward	0.895***	0.157***	0.0214	-0.0463**	-0.0155	1.774**	0.196	39	0.88	0	0.637
		(30.86)	(4.311)	(0.566)	(-2.428)	(-0.0331)	(2.260)	(1.347)				
	forward	0.898***	0.120**	0.0649	-0.0283	0.229	0.597	0.311	38	0.88	0	0.306
		(19.28)	(2.561)	(1.533)	(-0.637)	(0.148)	(0.258)	(1.065)				
Korea Rep.	*current*	0.831***	0.161**	0.0167**	0.0324***	-0.95***	0.338*	1.012***	39	0.93	0	0.116
		(26.14)	(2.233)	(2.212)	(5.248)	(-4.008)	(1.850)	(5.580)				
	backward	0.870***	0.0603	0.0157**	0.0363***	0.183	-0.109	0.369	39	0.92	0	0.181
		(11.47)	(0.800)	(2.522)	(3.490)	(0.377)	(-0.765)	(0.730)				
	forward	0.728***	0.182***	0.013**	0.0440***	0.118	-0.111	0.986***	35	0.91	0	0.174
		(12.60)	(3.058)	(2.014)	(6.637)	(0.482)	(-0.881)	(4.033)				

Table III6

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_0	Obs.	R^2	Ftest	Hansen J test
Mexico	*current*	0.802***	0.207	0.301***	-0.0640**	2.977**		0.429	42	0.92	0	0.193
		(12.61)	(1.330)	(3.925)	(-2.002)	(2.477)		(1.089)				
	backward	0.731***	0.140	0.292***	-0.0593*	1.209		1.365***	39	0.82	0	0.115
		(11.74)	(0.989)	(3.230)	(-1.903)	(0.749)		(3.121)				
	forward	0.840***	0.237	0.306***	-0.0645*	0.410		0.692	38	0.90	0	0.254
		(11.50)	(1.297)	(3.322)	(-1.790)	(0.385)		(1.296)				
Peru	*current*	0.852***	0.172	0.0245**	0.0415	0.359	0.536	0.345	35	0.65	0	0.156
		(10.10)	(1.409)	(2.057)	(1.332)	(0.326)	(0.473)	(0.958)				
	backward	0.770***	0.145**	0.0273**	0.0133	-0.115	0.808	0.760***	35	0.69	0	0.396
		(7.884)	(2.491)	(2.049)	(0.476)	(-0.190)	(1.272)	(2.652)				
	forward	0.814***	0.120*	0.0403**	-0.0393	0.256	-0.310	0.648	31	0.59	0	0.452
		(9.984)	(1.955)	(2.167)	(-1.074)	(0.260)	(-0.519)	(1.448)				
Philippines	*current*	0.970***	0.0312	0.00638	-0.051***	0.674	-0.667	-0.0533	35	0.86	0	0.387
		(17.78)	(0.874)	(0.644)	(-4.670)	(0.963)	(-1.016)	(-0.155)				
	backward	0.976***	0.0402*	0.00949	-0.055***	0.342	-0.696*	-0.0302	35	0.87	0	0.127
		(17.50)	(1.688)	(0.937)	(-3.947)	(0.757)	(-1.681)	(-0.0806)				
	forward	1.094***	0.0533*	0.00454	-0.068***	0.406	0.301	-1.069*	31	0.82	0	0.447
		(13.69)	(1.732)	(0.411)	(-6.349)	(0.790)	(0.568)	(-1.902)				
Poland	*current*	0.910***	0.288***	0.0222*	-0.0105	1.653	0.0850	0.142	42	0.98	0	0.482
		(32.91)	(3.577)	(1.899)	(-1.048)	(1.437)	(0.0380)	(0.757)				
	backward	0.850***	0.152***	0.00883	0.0274***	0.376	1.208*	0.425***	39	0.98	0	0.0374
		(36.61)	(3.533)	(1.062)	(2.591)	(0.368)	(1.671)	(3.713)				
	forward	0.897***	0.300***	0.032***	-0.00926	1.980*	0.762	0.0948	38	0.98	0	0.492
		(28.63)	(9.757)	(3.199)	(-1.034)	(1.886)	(0.732)	(0.493)				
South Africa	*current*	0.687***	0.172***	0.0549	-0.028***	2.329**	2.830	2.167***	41	0.93	0	0.391
		(12.81)	(3.929)	(0.832)	(-3.909)	(2.403)	(1.449)	(4.790)				
	backward	0.648***	0.195***	0.0941	-0.00287	2.814**	2.139	2.470***	39	0.93	0	0.493
		(13.81)	(4.530)	(1.328)	(-0.214)	(2.292)	(0.940)	(6.390)				
	forward	0.623***	0.152***	0.147**	-0.020***	0.991	3.211	2.987***	37	0.93	0	0.523
		(10.60)	(4.270)	(2.309)	(-2.796)	(1.508)	(1.092)	(5.647)				
Thailand	*current*	0.958***	0.131***	-0.0100	-0.0308*	0.403	0.0738	-0.202	41	0.93	0	0.321
		(23.18)	(4.121)	(-0.854)	(-1.658)	(0.680)	(0.327)	(-0.790)				
	backward	0.921***	0.127***	0.0003	-0.0292	0.796	-0.167	-0.231	39	0.93	0	0.256
		(20.75)	(6.195)	(0.0259)	(-1.644)	(1.497)	(-0.939)	(-1.030)				
	forward	0.971***	0.119***	-3.83e-05	-0.0444**	0.433	-0.311	-0.184	37	0.93	0	0.212
		(21.14)	(4.655)	(-0.002)	(-2.306)	(0.516)	(-1.502)	(-0.537)				

Two stages GMM estimates of equations (10). The list of instruments includes the second order difference of the explanatory variables and the log of the commodity price index. P values of F and Hansen J tests are reported. The F test is a test of the null hypothesis that all the coefficients, except the constant, are jointly significant. The Hansen J test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses.***, **, * indicate the statistical significance at 1, 5 and 10% restively.

All in all, the empirical investigation conducted in this section shows that the concerned for financial stability is not totally discarded within the inflation targeting regime, at least for emerging countries. Our conclusion is at variance with some criticisms regarding this monetary policy strategy, and describing inflation targeters as “inflation nutters”. On the contrary, we show that in emerging markets, targeters seem to implement a “flexible inflation targeting” strategy in which the policy instruments is not solely devoted to an inflation objective.

V. Conclusion

Since its advent in the early 1990s, inflation targeting has gained increasing interest among emerging countries. The relative performance of inflation targeting in stabilizing inflation is undoubtedly the most attractive characteristic of this policy framework. Indeed, compared to other monetary policy strategies, inflation targeting seems to perform better in achieving low and stable inflation, particularly among developing economies. However, in spite of these good achievements, the inflation targeting strategy has been criticized as a framework which is too focused on the inflation objective. Especially, in the aftermath of the 2008/2009 global financial crisis, it has been argued that monetary policy has been conducted without much concerns about imbalances in the financial sector; a criticism against the inflation targeting strategy. In this chapter, we shed light on that issue by attempting to investigate whether inflation targeting is associated with relatively higher fragility of the financial sector, and whether inflation targeters are less concerned with financial instability in their monetary policy-making. The analysis is based on a sample of 26 emerging markets economies, including 13 inflation targeters, with quarterly data over the period 2000Q1-2010Q4. We proceed in three main steps:

First, a general statistical analysis is conducted to get an overview of the financial conditions in targeting versus non-targeting countries. This preliminary assessment also intends to highlight potential regional differences regarding the financial sector’s behavior (the studied sample is divided into four main regional groups: Asia, Europe, Latin America and Middle East and Africa). We rely on a set of basic indicators providing valuable information on various types of risk (credit to GDP ratio, credit growth, credit to deposit ratio, share price index and bank foreign assets to total assets ratio). A first insight emerges from this initial analysis and suggests that, on average, despites some regional specific features, the financial sector in inflation targeting countries might be more fragile. Preliminary econometric estimations of the effect of inflation targeting on selected financial instability indicators support this first intuition. We find that inflation targeting is associated with higher credit as a share of GDP, higher credit to deposit ratio, higher share price index, but lower bank foreign assets to total assets ratio. However, we argue that such single indicators, taken separately, do not satisfactorily capture the financial conditions. A more complete definition and measure of the financial stance is needed.

Second, after a general discussion on some relevant issues in defining and measuring financial instability, we construct a composite index in order to get a more accurate and complete view of the financial environment in each country of the sample. The macro-financial condition index, generated with the principal component analysis technic, shows good retrospective performances in capturing periods of financial instability in many cases. The effect of inflation targeting on financial instability is reassessed, relying this more accurate measurement of the financial stance. In addition to the traditional panel data analysis, the propensity score matching approach, recently implemented in empirical studies assessing the performances of inflation targeting, is performed to overcome a potential self-selection bias in adoption of the targeting regime. Overall, we find a positive, statistically significant, and robust effect of the adoption of inflation targeting on our measure of financial instability. That is to say, financial sectors in inflation targeting countries are, on average, more fragile compared to those of non-targeting countries. This conclusion raises another relevant question which is whether inflation targeters completely discard the concern for financial stability when conducting their monetary policy.

Therefore, finally the chapter assesses the extent to which targeting central banks respond to financial risks in their monetary policy-making. To this end, Taylor-type rules, augmented with financial variables, are estimated both by group of targeting versus non-targeting countries, and by country within the inflation targeters group. Linear as well as asymmetric central banks' reaction functions are considered, in order to control for the possibility that the monetary authorities may be concerned with the issue financial stability, only once their primary inflation stabilization objective is achieved. We also consider alternative specifications of the reaction functions corresponding to assumptions on the timing of the central banks' responses. Estimates of the augmented Taylor rules by group reveal that, contrary to non-targeters, the policy instrument responds to financial imbalances in inflation targeting countries. Since this finding for the group of targeters can hide some disparities among individual countries, we further assess the central banks reaction function on a country-by-country basis. The results show that, for 8 of the 13 inflation targeters, central banks respond to financial instability in their monetary policy-making.

The main conclusions of this chapter may be instructive in two main ways. First, our findings on the assessment of the monetary policy-making in inflation targeting countries do not support the criticism that inflation targeters are too focused on their inflation objective and discard potential imbalances in the financial sector. We rather show that, at least in emerging countries, most targeters implement restrictive monetary policies in response to raising financial disequilibria, although, in some cases, this response depends on achievements regarding the inflation objective. Second, we find that despites their response to financial instability, the financial sector in inflation targeting countries is more vulnerable than that of their non-targeting counterparts. This is instructive in the sense that, our results calls into question the relevance of the so-called "leaning against the wind" policy which argues that central banks should tighten the monetary policy stance to dampen increasing risks in financial sector. To some extent, our findings seem to suggest that such a strategy may be inefficient to deal with concerns for financial instability. Another possible explanation to our findings is that, responses from targeting central banks are not strong or aggressive enough to have the desire impact on the financial sector. Relying on a theoretical framework, the next chapter deals with these particular issues.

Despites strong and diligent efforts to ensure the robustness of our analysis, the empirical investigation conducted in this chapter is not free from limitations. Two main issues can deserve a particular attention. The first is related to the studied period which is relatively short (11 years). The adoption and implementation of inflation targeting in emerging countries mostly take place in the late 1990s and early 2000s. Besides, quarterly data on the financial/banking sector in most emerging markets are not available before the early 2000s. Because of these limitations, it is difficult carry out our empirical analysis before 2000. A second possible limitation of the study is the lack of some relevant financial indicators (such as house prices, asset prices, or currency mismatch) which provide valuable information on the health of the financial sector. These data are not available for most emerging countries, except in more recent periods in some cases. The Financial Soundness Indicators database launched by the International Monetary Fund compiles series of financial variables since 2005 and will help improve future studies on the financial conditions in emerging countries. Our empirical investigation is a first attempt in this regard.

Appendices

Appendix table III.1: Sample

Inflation targeters	Non-inflation targeters
Brazil (1999Q2)	Argentina
Chile (1999Q4)	Bahrain, Kingdom of
Colombia (1999Q4)	Bulgaria
Czech Republic (1997Q4)	Croatia
Hungary (2001Q2)	Kuwait
Israel (1997Q2)	Malaysia
Korea, Republic of (2001Q1)	Morocco
Mexico (2001Q1)	Nigeria
Peru (2002Q1)	Pakistan
Philippines (2002Q1)	Russian Federation
Poland (1998Q3)	Singapore
South Africa (2000Q1)	Ukraine
Thailand (2000Q2)	Venezuela, Rep. Bol.

Inflation targeting adoption date in parentheses (Source: Roger (2009))

Appendix table III.2: Correlation matrix of the macroeconomic and financial indicators

	Credit to GDP	Credit growth	Systemic liquidity	Capital flow	Net foreign assets growth	Interest rate spread	Share price index	M2 to GDP
Credit to GDP	1.0000							
Credit growth	-0.4696*	1.0000						
Systemic liquidity	0.4075*	-0.2906*	1.0000					
Capital flow	0.1941*	-0.1013*	0.0708*	1.0000				
Net foreign assets growth	0.0736*	0.0435	0.2543*	-0.2520*	1.0000			
Interest rate spread	-0.2137*	0.1617*	-0.1119*	-0.1814*	0.6611*	1.0000		
Share price index	-0.0385	-0.2170*	0.0007	-0.2649*	0.0924*	0.1730*	1.0000	
M2 to GDP	0.8633*	-0.4870*	0.4962*	0.2839*	0.0694*	-0.2991*	-0.1203*	1.0000

* indicates the statistical significance at 5% or below.

Appendix table III.3: PCA loadings

	Credit to GDP	Credit growth	Systemic liquidity	Capital flow	Net foreign assets growth	Interest rate spread	Share price index	M2 to GDP	**Share of total variance (%)**
Argentina	0.388	-0.388	0.380	0.418	0.152	0.145	-0.382	-0.437	62.05
Bahrain. Kingdom of	0.132	0.424	-0.388	0.194	0.039	-0.338	0.536	-0.460	40
Brazil	0.444	0.074	0.351	-0.386	-0.169	-0.362	0.437	0.418	60
Bulgaria	0.477	-0.069	0.484	-0.422	-0.118	0.064	0.324	0.484	51
Chile	0.535	-0.054	0.289	0.231	0.142	0.305	0.414	0.538	39
Colombia	0.466	0.058	0.205	0.356	0.008	-0.405	0.466	0.479	50
Croatia	0.486	-0.294	0.424	-0.333	0.175	-0.223	0.428	0.352	40
Czech Republic	0.493	0.203	0.492	-0.140	-0.122	0.165	0.401	0.501	41.3
Hungary	0.494	-0.102	0.484	0.256	-0.064	0.169	0.423	0.484	50
Israel	0.507	-0.015	-0.474	0.017	0.096	-0.302	0.496	0.414	40
Korea. Republic of	0.516	-0.186	0.147	0.209	-0.088	0.313	0.440	0.578	36
Kuwait	-0.034	0.142	0.447	0.441	0.102	0.301	0.509	-0.474	44
Malaysia	-0.444	0.144	-0.355	0.204	-0.017	-0.396	0.479	0.478	45.6
Mexico	0.507	0.067	0.417	-0.104	-0.180	0.227	0.488	0.482	45
Morocco	0.442	0.249	0.000	0.216	-0.153	-0.484	0.490	0.444	48.6
Nigeria	0.473	-0.009	0.439	-0.390	-0.226	0.413	0.196	0.415	51
Pakistan	-0.299	-0.054	-0.372	0.325	0.397	0.434	-0.431	0.363	49
Peru	0.536	-0.291	0.387	0.086	-0.214	-0.364	-0.321	0.435	33
Philippines	0.551	-0.168	0.441	-0.289	-0.071	-0.203	-0.452	0.374	35.5
Poland	0.533	-0.066	-0.131	-0.155	-0.063	0.505	0.349	0.539	41.4
Russian Federation	0.483	-0.263	0.435	0.055	-0.150	-0.285	0.426	0.470	51.2
Singapore	-0.366	0.185	-0.507	0.471	-0.043	-0.034	0.482	0.343	42.1
South Africa	-0.268	0.217	0.019	0.317	-0.241	-0.484	0.455	0.531	40.3
Thailand	0.405	-0.009	-0.356	0.146	0.284	0.424	-0.436	0.489	47.2
Ukraine	0.528	-0.199	0.364	0.221	-0.048	-0.270	0.435	0.486	43.1
Venezuela. Rep. Bol.	0.464	0.127	-0.435	-0.235	-0.071	-0.111	0.496	0.510	45.1

Appendix table III.4: Probit model of the propensity score matching estimates

Dependent variable: Inflation targeting dummy			
	(1)	(2)	(3)
Inflation rate	-0.0965***	-0.0997***	-0.0873***
	(-4.524)	(-4.590)	(-3.521)
Real GDP per capita growth	-0.00592	-0.00502	-0.0105
	(-0.731)	(-0.584)	(-1.133)
Log real GDP	-0.247***	-0.487***	-0.154
	(-2.699)	(-4.492)	(-1.467)
Short term interest rate	0.155***	0.191***	0.175***
	(5.767)	(6.562)	(5.512)
Long term interest rate	-0.187***	-0.232***	-0.205***
	(-6.663)	(-7.283)	(-6.268)
Trade openness	-0.000101***	-0.000118***	-8.53e-05***
	(-8.180)	(-7.877)	(-6.434)
Fixed exchange rate regime	-2.707***	-3.180***	-2.485***
	(-13.61)	(-13.79)	(-11.11)
Central bank independence	1.980***	3.906***	2.212***
	(6.033)	(6.597)	(5.785)
Constant	7.185***	10.34***	4.997**
	(3.580)	(4.447)	(2.167)
Regional dummies	-	Yes	-
Observations	845	845	644
Pseudo R^2	0.553	0.581	0.547

Column (1) presents the results for the baseline model (on the entire period); column (2) the results when controlling for regional dummies. from the baseline; and column (3) the results when the sample is restricted to the 2000Q2-2008Q2 period. T-statistics reported in parentheses.***. **. * indicate the statistical significance at 1, 5 and 10% restively.

Appendix table III.5: Standard central bank reaction function

	δ_1	δ_2	δ_3	δ_4	δ_0	Obs.	R^2	F test	Hansen J test
Brazil	0.879***	0.235**	0.113**	-0.0351**	1.406**	42	0.886	0	0.271
	(18.39)	(2.568)	(2.282)	(-2.073)	(2.167)				
Chile	0.446***	0.359***	0.0794**	-0.00345	2.014***	42	0.740	0	0.102
	(5.041)	(5.412)	(2.500)	(-0.130)	(6.127)				
Colombia	0.791***	0.251***	0.105**	-0.00488	1.202***	41	0.923	0	0.657
	(15.63)	(2.747)	(1.974)	(-0.308)	(3.516)				
Czech Rep.	0.863***	0.0665***	0.0322***	-0.0319***	0.356***	41	0.940	0	0.254
	(20.88)	(3.873)	(3.010)	(-2.792)	(2.935)				
Hungary	0.840***	0.122*	0.0611***	-0.107***	1.042	38	0.746	0	0.254
	(11.80)	(1.933)	(2.720)	(-2.818)	(1.632)				
Israel	0.937***	0.152**	0.0825**	-0.0394	0.215	42	0.904	0	0.411
	(26.03)	(2.379)	(2.138)	(-1.501)	(1.452)				
Korea Rep.	0.851***	0.0523	0.0131**	0.0327***	0.526***	38	0.921	0	0.210
	(19.48)	(0.772)	(2.402)	(4.912)	(3.360)				
Mexico	0.811***	0.298*	0.304***	-0.0727**	0.913**	41	0.901	0	0.731
	(13.58)	(1.764)	(3.488)	(-2.104)	(2.254)				
Peru	0.867***	0.126*	0.0396**	0.00292	0.534**	35	0.646	0	0.249
	(10.07)	(1.787)	(2.350)	(0.0752)	(1.975)				
Philippines	0.972***	0.0567**	0.00587	-0.0565***	-0.0607	35	0.869	0	0.305
	(16.40)	(2.258)	(0.575)	(-4.321)	(-0.160)				
Poland	0.920***	0.290***	0.0317**	-0.0151	0.312**	42	0.980	0	0.302
	(38.88)	(7.536)	(2.138)	(-1.514)	(2.197)				
South Africa	0.692***	0.159***	0.0908	-0.0210**	2.410***	41	0.923	0	0.366
	(10.47)	(3.394)	(1.236)	(-2.218)	(4.459)				
Thailand	0.969***	0.112***	-0.00235	-0.0432**	-0.0298	41	0.933	0	0.521
	(22.95)	(4.422)	(-0.206)	(-2.275)	(-0.337)				

Two stages GMM estimates of equations (8). The list of instruments includes the second order difference of the explanatory variables and the log of the commodity price index. P values of F and Hansen J tests are reported. The F test is a test of the null hypothesis that all the coefficients. except the constant. are jointly significant. The Hansen J test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses.***. **. * indicate the statistical significance at 1. 5 and 10% restively.

Appendix table III.6: Central banks responses to selected financial indicators

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_0	Obs.	R^2	Ftest	Hansen J test
Brazil	Δ*credit/GDP*	0.893***	0.246***	0.137**	-0.0378**	0.156	1.038	42	0.886	0	0.422
		(19.84)	(2.918)	(2.529)	(-2.249)	(1.014)	(1.526)				
	Δ*share price*	0.875***	0.238***	0.114**	-0.0305*	-0.0158	1.478**	42	0.893	0	0.258
		(18.56)	(2.686)	(2.453)	(-1.927)	(-1.194)	(2.324)				
	Δ*capital flow*	0.867***	0.252***	0.0849*	-0.0232	-0.273	1.470**	42	0.896	0	0.131
		(17.21)	(2.942)	(1.659)	(-1.488)	(-0.434)	(2.139)				
Chile	Δ*credit/GDP*	0.465***	0.350***	0.0870***	-0.00322	0.209**	1.908***	42	0.794	0	0.189
		(6.249)	(5.047)	(2.689)	(-0.145)	(2.324)	(6.303)				
	Δ*share price*	0.467***	0.348***	0.109***	-0.0215	-0.00341	2.028***	42	0.751	0	0.192
		(5.810)	(5.170)	(3.492)	(-0.809)	(-0.562)	(7.025)				
	Δ*capital flow*	0.460***	0.360***	0.0669**	-0.00683	0.0598	1.977***	41	0.727	0	0.324
		(3.343)	(3.834)	(2.023)	(-0.274)	(0.521)	(4.289)				
Colombia	Δ*credit/GDP*	0.806***	0.305***	0.0486	-0.00629	0.298**	0.952***	41	0.933	0	0.264
		(15.57)	(3.744)	(0.928)	(-0.403)	(2.549)	(2.780)				
	Δ*share price*	0.793***	0.245***	0.107*	-0.00659	-0.000318	1.192***	41	0.922	0	0.763
		(15.76)	(2.703)	(1.931)	(-0.452)	(-0.0274)	(3.238)				
	Δ*capital flow*	0.788***	0.255***	0.102*	-0.00436	-0.00928	1.223***	41	0.923	0	0.752
		(16.07)	(2.775)	(1.922)	(-0.280)	(-0.261)	(3.679)				
Czech Rep.	Δ*credit/GDP*	0.871***	0.0744***	0.0352***	-0.036***	-0.00204	0.351***	41	0.940	0	0.175
		(21.26)	(4.493)	(3.310)	(-3.185)	(-0.189)	(2.958)				
	Δ*share price*	0.861***	0.0647***	0.0315***	-0.032***	-0.00285	0.370***	41	0.942	0	0.251
		(21.14)	(3.735)	(2.747)	(-2.873)	(-1.179)	(3.055)				
	Δ*capital flow*	0.881***	0.0650***	0.0238**	-0.025**	0.0277	0.294***	41	0.942	0	0.332
		(23.16)	(4.293)	(2.038)	(-2.337)	(0.956)	(2.617)				
Hungary	Δ*credit/GDP*	0.809***	0.0494	0.0687***	-0.0704**	-0.0287	1.448***	39	0.703	0	0.553
		(13.17)	(0.837)	(3.038)	(-1.987)	(-1.092)	(2.697)				
	Δ*share price*	0.825***	0.102	0.0677***	-0.088***	-0.00625	1.258**	39	0.709	0	0.389
		(13.69)	(1.627)	(3.030)	(-2.681)	(-0.676)	(2.242)				
	Δ*capital flow*	0.823***	0.0763	0.0743***	-0.0815**	0.0371	1.296**	39	0.704	0	0.710
		(13.37)	(1.175)	(4.052)	(-2.316)	(0.758)	(2.350)				
Israel	Δ*credit/GDP*	0.911***	0.0658	0.0761**	-0.0262	-0.0693	0.250*	42	0.894	0	0.359
		(27.13)	(1.245)	(2.362)	(-1.023)	(-1.616)	(1.665)				
	Δ*share price*	0.942***	0.186***	0.140***	-0.0540**	0.0173*	0.199	42	0.909	0	0.390
		(25.58)	(3.057)	(3.186)	(-2.229)	(1.800)	(1.273)				
	Δ*capital flow*	0.917***	0.0931**	0.0568*	-0.0197	0.0334	0.211	42	0.895	0	0.262
		(26.58)	(1.969)	(1.697)	(-0.834)	(1.238)	(1.336)				
Korea Rep.	Δ*credit/GDP*	0.785***	0.0282	0.0145**	0.0280***	0.0680***	0.728***	38	0.924	0	0.195
		(18.26)	(0.494)	(2.306)	(4.595)	(3.260)	(4.839)				
	Δ*share price*	0.862***	0.0396	0.0125**	0.0321***	-0.000785	0.488***	38	0.921	0	0.287
		(21.04)	(0.601)	(2.245)	(4.783)	(-0.323)	(3.339)				
	Δ*capital flow*	0.842***	-0.0301	0.0136**	0.0240***	0.162***	0.587***	39	0.926	0	0.142
		(19.14)	(-0.488)	(2.296)	(3.081)	(3.056)	(3.717)				

Appendix table III.6

		δ_1	δ_2	δ_3	δ_4	δ_5	δ_0	Obs.	R^2	Ftest	Hansen J test
Mexico	Δ*credit/GDP*	0.863***	0.170	0.341***	-0.089***	-0.361*	0.716*	42	0.918	0	0.233
		(15.66)	(1.144)	(3.688)	(-2.841)	(-1.773)	(1.945)				
	Δ*share price*	0.860***	0.184	0.294***	-0.0618*	-0.00425	0.696	42	0.915	0	0.0986
		(14.17)	(1.077)	(3.447)	(-1.842)	(-0.509)	(1.525)				
	Δ*capital flow*	0.866***	0.181	0.302***	-0.0690*	-0.0180	0.621	42	0.915	0	0.252
		(14.39)	(1.060)	(3.331)	(-1.958)	(-0.353)	(1.472)				
Peru	Δ*credit/GDP*	0.835***	0.108*	0.0389**	-0.0114	0.0790	0.575**	35	0.663	0	0.258
		(9.638)	(1.875)	(2.213)	(-0.272)	(0.634)	(2.040)				
	Δ*share price*	0.817***	0.157**	0.0431**	0.00514	0.00212	0.665**	35	0.676	0	0.241
		(9.710)	(2.226)	(2.198)	(0.145)	(0.860)	(2.521)				
	Δ*capital flow*	0.859***	0.123*	0.0396**	0.00732	0.0363	0.556**	35	0.650	0	0.295
		(10.30)	(1.733)	(2.354)	(0.175)	(0.671)	(2.121)				
Philippines	Δ*credit/GDP*	0.984***	0.0271	0.00395	-0.021***	-0.0315	0.0413	35	0.956	0	0.211
		(32.73)	(1.551)	(0.446)	(-3.126)	(-0.565)	(0.218)				
	Δ*share price*	0.980***	0.0514	0.00543	-0.072***	0.00334*	-0.241	35	0.772	0	0.177
		(13.89)	(1.410)	(0.452)	(-4.693)	(1.756)	(-0.513)				
	Δ*capital flow*	1.018***	0.00165	0.00740	-0.036***	0.0453**	-0.241	34	0.962	0	0.177
		(28.71)	(0.103)	(1.012)	(-4.535)	(2.479)	(-1.051)				
Poland	Δ*credit/GDP*	0.911***	0.301***	0.0185	-0.00502	-0.102	0.442**	42	0.980	0	0.296
		(34.11)	(7.313)	(1.633)	(-0.458)	(-1.051)	(2.332)				
	Δ*share price*	0.905***	0.193***	0.0217	0.00801	0.00290	0.339*	41	0.978	0	0.240
		(28.86)	(3.676)	(1.536)	(0.701)	(1.062)	(1.894)				
	Δ*capital flow*	0.905***	0.181***	0.0121	0.0108	-0.0424	0.364**	41	0.977	0	0.187
		(28.95)	(3.308)	(1.359)	(0.965)	(-1.379)	(2.190)				
South Africa	Δ*credit/GDP*	0.696***	0.144***	0.0969	-0.023***	0.00847*	2.422***	41	0.924	0	0.486
		(10.40)	(2.861)	(1.357)	(-2.811)	(1.658)	(4.515)				
	Δ*share price*	0.699***	0.156***	0.0917	-0.0192**	0.00146	2.368***	41	0.923	0	0.386
		(10.75)	(3.304)	(1.242)	(-2.076)	(0.219)	(4.449)				
	Δ*capital flow*	0.656***	0.165***	0.0989	-0.026***	0.0827**	2.698***	41	0.934	0	0.430
		(11.90)	(3.742)	(1.568)	(-3.021)	(2.113)	(5.981)				
Thailand	Δ*credit/GDP*	0.965***	0.116***	-0.00303	-0.0400**	0.000567	-0.0328	41	0.933	0	0.590
		(22.70)	(4.575)	(-0.247)	(-2.137)	(0.188)	(-0.369)				
	Δ*share price*	0.972***	0.104***	-0.00187	-0.0455**	-0.00115	-0.0289	41	0.932	0	0.601
		(22.46)	(4.837)	(-0.161)	(-2.347)	(-0.303)	(-0.299)				
	Δ*capital flow*	0.967***	0.109***	-0.00338	-0.0453**	-0.00680	-0.0298	41	0.933	0	0.506
		(22.94)	(4.249)	(-0.316)	(-2.392)	(-0.205)	(-0.337)				

Two stages GMM estimates of equations (9). The list of instruments includes the second order difference of the explanatory variables and the log of the commodity price index. P values of F and Hansen J tests are reported. The F test is a test of the null hypothesis that all the coefficients. except the constant. are jointly significant. The Hansen J test of overidentifying restrictions tests the null hypothesis that the instruments are valid. Robust t-statistics reported in parentheses.***. **. * indicate the statistical significance at 1. 5 and 10% restively.

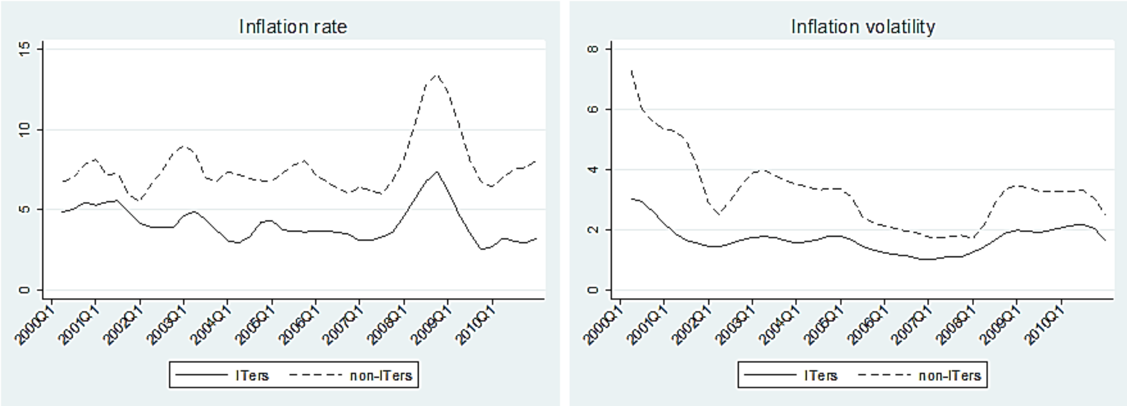
Appendix table III.7: Data sources

Variable	Description	Source
Credit	Banking system total claims on private sector	IFS and central banks statistics
Total deposit	Total stock of deposit in the banking system	IFS and central banks statistics
Banks foreign assets	Total banking system claims on non-residents	IFS and central banks statistics
Banks foreign liabilities	Total banking system liabilities on non-residents	IFS and central banks statistics
Net foreign assets	Sum of foreign assets less sum of foreign liabilities in the banking system	IFS and central banks statistics
Banks total assets	Banking system net foreign + total domestic claims	IFS and central banks statistics
Share price index	Common shares of companies traded on stock exchanges	IFS and national statistics
GDP	Gross domestic product	IFS and national statistics
GDP growth	Percent changes of GDP	Author calculation based on IFS data
Real GDP	Gross domestic product deflated by the GDP deflators	Author calculations based in IFS data
Real GDP per capita	Real DGP divided by the population size	IFS and national statistics
Inflation	Change in consumption price index	IFS
Inflation volatility	Twelve months moving average standard deviation o f inflation	Author calculations based on IFS data
Short term interest rate	Money market rates	IFS and central banks statistics
Deposit rate	Rate offered for demand. time or saving deposits to Banks	IFS and central banks statistics
Lending rate	Rate that usually meets the short and medium term refinancing needs of the private sector	IFS and central banks statistics
Exchange rate	US dollars per national currency effective exchange rate	IFS and BIS
Exchange rate volatility	Twelve months moving average standard deviation of exchange rate	Author calculation based on IFS and BIS
M2	Money and quasi money	IFS and central banks statistics
Fed funds rate	Rate at which the depository institutions trade funds held at the US Federal Reserve	IFS
Economic globalization	Measure of countries economic globalization (KOF index)	Dreher (2006.updated2011)
Central bank independence	Cukierman. Webb and Neyapti index of central independence	Cukierman et al. (1992) updated in Crowe and Meade (2008)
Law and order	Index of strength and impartiality of the legal system. and enforcement of law	International Country Risk Guide
Fixed exchange rate	Dummy = 1 for fixed exchange rate regime and 0 otherwise. The dummy is constructed based on the "coarse classification" of exchange rate regimes by, Reinhart and Rogoff .	Author, based on Reinhart and Rogoff data (2011).

Appendix figure III.1: The MFCI

<u>Appendix figure III.1</u> (continued)

Appendix figure III.2: Inflation performances in targeting vs non-targeting countries



Chapter IV

On the Effectiveness of "Leaning Against the Wind" and Macroprudential Policy*

"[…] we ought to be open-minded in thinking about how to best use the full array of instruments at our disposal. Indeed, in some cases, it may be that the only way to achieve a meaningfully macroprudential approach to financial stability is by allowing for some greater overlap in the goals of monetary policy and regulation." (Stein, 2013)

I. Introduction

The concern for financial stability has long been a critical question for central banks, since monetary policy is set to contribute to the overall economic stability. The relevance of the financial stance in the monetary policy-making has been strengthened more recently in the literature by highlighting the close connection between financial stability and the monetary policy. Monetary policy can feed financial imbalances in various ways, as discussed in more

* The analysis conducted in this chapter is a work in collaboration with A. Popescu.

details in chapter I. According to the risk-taking channel (Borio and Zhu, 2012), maintaining low interest rates for a protracted period of time increases financial risks through higher incentives to search for yields (Rajan, 2005). Moreover, for financial firms, low interest rates increase interest margins, raising the firm's value and thereby their leverage and their risk exposure (Adrian and Shin, 2010). A credible and predictable monetary policy can also favor risk-taking by reducing uncertainties and leading to underestimation of risk by financial market participants. For households and entrepreneurs, low interest rates increase the value of collateral and can fuel credit, raising concerns for financial stability.

Until 2007, the debate, both inside and outside central banks, was somewhat focused on whether or not monetary policy should respond to financial imbalances (the "clean" versus "lean" debate).[68] While the cleaning approach seems to prevail before the crisis, the latter has however underlined two major limits of this strategy. First, the crash of the housing price bubble in 2007 has shown that the economic costs of a financial crisis can be very high and persistent.[69] As pointed out by Woodford (2012), in spite of unprecedented measures undertaken by number of central banks in the aftermath of the global financial crisis, authorities were unable to avoid a sharp contraction of the global economic activity. Years after the subprime crisis, many economies are still struggling with its harmful effects. Second, the pre-crisis period showed that a trade-off can emerge between macroeconomic stability and financial stability. Despite the central banks' success in maintaining a low and stable inflation since the early 2000s, financial risks accumulated during this period and culminated in the house price bubble crash. De Grauwe and Gros (2009) argue that a trade-off between inflation and financial stability can emerge when the economy faces a technological shock, or when the investors' behavior is characterized by too optimistic beliefs on the financial markets (the "animal spirits").

Consequently, the leaning against the wind view, as a way to keep the financial sector safe, has gained importance. The debate has moved from the question of whether to act, to the issue of how to act. Raising the interest rate would help dampen excessive risk taking. As stated by Rudebusch (2005), ideally, a moderate adjustment of the interest rate could constrain the

[68] These two approaches and related arguments are discussed in more detail in chapter I.

[69] We provide more details regarding the effects of the crisis in the introduction.

bubble and reduce the risk of important macroeconomic disturbance. However, the trade-off between macroeconomic and financial stability remains a relevant issue when adopting a leaning against the wind strategy. Recent research takes interest in the existence of trade-offs in the monetary policy setting. A trade-off can emerge because of the violation of the Tinbergen principle. Relying on a single instrument for two objectives may lead to undesirable policy achievements. The literature stressing potential trade-offs between central bank's objectives when the latter is concerned with financial issues includes Issing (2003), De Nicolo et al. (2010), King (2012), as discussed in chapter I. Furthermore, Mishkin (2011) argues that it may be dangerous to use monetary policy to promote financial stability because such a framework can require tightening monetary policy when it is not needed at the macroeconomic level.

In the above mentioned literature, conclusions with respect to the trade-off are reached only by analyzing the economic conditions and without explicitly resorting to a model. To the best of our knowledge, there is no research paper that explicitly takes interest in the existence of trade-offs in a leaning against the wind setup;[70] an issue we deal with in the first part this chapter. Recall also that results from the empirical analysis conducted in chapter III suggest that the leaning against wind strategy may be ineffective in providing better financial stability conditions. These concerns regarding the possible conflict of objectives in the leaning approach of the monetary policy-making, and the relevance of this strategy in improving the financial conditions, have highlighted the need for a broader framework which includes additional tools to deal with financial risks. Especially, as argued in chapter I, macroprudential policies are discussed in the current debate as policy frameworks expected to safeguard the stability of the financial system. This issue is assessed in the second part of the chapter.

The chapter first investigates theoretically the existence of trade-offs between macroeconomic and financial stability, when the central bank responds to financial imbalances by setting the short term interest rate. The theoretical framework starts from a standard reduced form three-equation new Keynesian model that we supplement with a fourth equation which reflects the

[70] However, the issue is partly addressed in the presence of macroprudential policies in several DSGE models such as Agenor et al. (2013), Beau et al. (2013), or Christensen et al. (2011). For an empirical assessment of trade-offs, see End (2010).

evolution of an asset price bubble. It is assumed that deviations of asset price from the fundamental value (the bubble process) captures the risk accumulation in the financial sector. We endogenize the bubble process by assuming that the policy interest rate has an influence on the bursting probability of the bubble. In the end, monetary policy affects both the bubble's duration and its amplitude. Furthermore, the financial bubble is assumed to have an impact on the aggregate demand. In order to assess the extent to which monetary policy is effective in achieving its objectives, we explore the changes in inflation, output gap and bubble volatilities for various types of shocks and alternative responses from the central bank.

Our results suggest that, when the central bank reacts directly to financial imbalances, a trade-off indeed emerges between its primary objective of macroeconomic stability and the financial stability objective. Moreover, these results also show that when central bank responses become too aggressive, this strategy may be counterproductive since it generates an increase in macroeconomic and financial instability. These findings emphasize the limits of the leaning against the wind strategy, and to some extent, support the argument that while financial stability remains a major concern, central banks should focus on their traditional inflation (and output gap) stability objective(s) and rely on other (macroprudential) instruments to deal with financial imbalances.

To investigate the extent to which including a prudential instrument in the policy framework can improve the stabilization outcomes, the second part of the chapter extend the model described above and includes a banking sector. The latter is described by loan supply and demand equations, the bank deposit equation and the bank capital accumulation equation. This new theoretical framework relies on the assumption that the increase in loan supply increases financial risks by inflating the asset price bubble. The purpose of the prudential instrument is therefore to control the credit supply. Especially, we follow the Basel Committee on Banking Supervision (BCBS) which recommends constraining the bank capital in order to build regulatory buffers. Two alternative formulations of the prudential instrument are considered: fixed capital requirements and countercyclical capital requirements. By constraining the bank loan supply, capital requirements are expected to deflate the bubble or avoid the asset price bubble growth, and ultimately reduce the financial risk. We also consider a policy framework in which in addition to the prudential policy, the central bank can take actions and respond to financial shocks.

The findings from the comparative analysis of various response strategies considered with this new theoretical framework can be summarized as follows: first, the implementation of the prudential instrument (fixed or countercyclical capital requirements) provides better financial stability outcomes than the strategy in which the sole monetary policy instrument is used to achieve macroeconomic and financial stability. Second, in line with the Basel III reforms, the results suggest that the regulatory buffer which adjusts with perceived level of system-wide risk (the countercyclical capital requirements) performs better (than the fixed) in stabilizing the financial sector. Third, we find that a two-pillar framework in which the implementation of the prudential policy is complemented with the leaning against the wind strategy provides better macroeconomic and financial stabilization outcomes, when faced with financial shocks. Finally, when assuming that financial and supply shocks occur simultaneously, our comparative analysis of various response strategies seems to be inconclusive. This may suggest that the best strategy might rather depend on the current financial and macroeconomic stability conditions, and the potential consequences of further financial or macroeconomic instability.

The chapter is organized as follows. Section II sets our first theoretical framework. It presents the bubble process and the macroeconomic setup, discusses the main results and provides some robustness checks. Section III extends this first model by introducing a banking system and the macroprudential instrument. It discusses the simulations' results and proceeds with a comparative analysis of alternative policy strategies. Section IV concludes.

II. Leaning against the wind strategy and trade-offs

This section investigates the existence of trade-offs in the monetary policy-making, when the central bank responds to financial imbalances. First, it presents the theoretical model with an emphasize on the bubble process. Second, it discusses results from different scenarios considered. And finally, some robustness tests are conducted.

II.1. The model

The discussion relies on the reduced form new Keynesian model describing the economy through equations for aggregate demand, aggregate supply, and the central bank's reaction function. This conventional three-equation model is supplemented with a fourth relation describing risk accumulation in the financial market, *i.e.* an asset price bubble. The bubble's equation is presented in the first part of this section, before introducing the whole macroeconomic model.

II.1.a. The bubble

The bubble equation is inspired by the Blanchard and Watson (1982) rational asset price bubble and takes the following linear form:

$$b_t = \begin{cases} \frac{1+\bar{i}}{\bar{q}}(b_{t-1} - \tilde{q}_t) + \varepsilon_t^b & \textit{if the bubble persists}, (q_t) \\ \varepsilon_t^b & \textit{otherwise}, (1-q_t) \end{cases} \tag{1}$$

where b_t, the bubble, is the asset price deviation from its fundamental value. The bubble is assumed to persist with the probability q_t and to burst with the probability $(1-q_t)$. $\bar{i}$ is the equilibrium interest rate, $\bar{q}$ is the threshold value of q_t above which the bubble bursts, $\tilde{q}_t$ is the difference between q_t and $\bar{q}$, and ε_t^b is an exogenous shock with zero mean. Equation (1) suggests that the bubble is self-fulfilling and growth without any connection to fundamentals, with $\frac{1+\bar{i}}{\bar{q}} > 1$. Holding an asset experiencing a price bubble can therefore be motivated by the expectation that the price will continue to growth in subsequent periods.

The bubble process, as discussed so far is completely exogenous, since it is not affected by any economic or policy changes. Such exogenous bubble has been used in the existing literature (see Bernanke and Gertler, 1999; Cecchetti et al., 2000; Badarau and Popescu, 2014, among others). However, and particularly since the 2008/2009 global financial crisis, it is now widely recognized that the monetary policy stance can affect stakeholders' risk-taking behavior. More especially, it has been argued that by implementing a tight monetary policy, central banks can avoid financial bubbles or mitigate the negative macroeconomic effects which can emerge when they burst.[71] Following this argumentation, and for the purpose of endogenizing the bubble process, we rely on the realistic assumption that the short term interest rate can affect the bubble by influencing its lasting probability q_t as follows:

[71] See the discussion in chapter I.

$$\tilde{q}_t = -\gamma \Delta i_{t-1} \tag{2}$$

where Δi_{t-1} denotes the changes in the short term interest rate from one period to another. Equation (2) suggests that monetary policy can lower the lasting probability of the bubble by raising the short term interest rate. Doing so will, by construction, increase the bursting probability, thus diminish the duration of the bubble. Such an action from the monetary authority may be well justified by the willingness to limit the disruptive consequences of a bubble collapse. As a means of prevention, the central bank may wish to prick the bubble before the risk accumulation becomes excessive. However, this policy affects not only the duration, but also the size of the bubble. Indeed, increasing the interest rate will translate in an upward reaction of the bubble.[72]

In the expression of $\tilde{q}_t$, it is assumed that changes in the interest rate matter more for the financial sector than levels. Consider for example a first situation in which the short term rate rises from 1 to 2%, and a second one where the rate goes from 1,5 to 2%. In both situations, the interest rate reaches the same level. However, in the first case, the rate increases by 1 percentage point, whereas the increase is of only 0.5 in the second case. We argue that financial markets will be more affected in the first scenario compared to the second one.[73,74]

Substituting equation (2) in the bubble's expression (1) yields:

$$b_t = \left[\frac{1+\bar{i}}{\bar{q}} (b_{t-1} + \gamma \Delta i_{t-1}) \right] D + \varepsilon_t^b \tag{3}$$

[72] Gali (2014) also argues that an increase in the policy rate in reaction to a growing bubble will entail a positive effect on the bubble's growth.

[73] The main conclusions from our model do not change if we consider the levels rather than the changes of the short term rate in equation (2). See the robustness section for more details.

[74] Gruen et al. (2005) use a similar approach to make the bubble process endogenous to policy setting. They build a macroeconomic model that includes a role for an asset price bubble and compare the optimal monetary policy response for two types of policymakers: a skeptic one which implements a (standard) inflation targeting-type policy, and an activist one which responds to asset price bubbles. In their sensitivity analysis, they assume that the bursting probability of the bubble is affected (with a lag) by the difference between the short term rate and its optimal path, chosen by the skeptic policymaker.

where D is a dummy variable which takes the value of 1 as long as the bubble lasts, and 0 when it bursts (*i.e.* when $q_t > \bar{q}$). The macro-model describing the economic framework, discussed in the next subsection, will be augmented with this expression of the asset price bubble.

II.1.b. The macroeconomic framework

The three-equation new Keynesian model is used to describe the macroeconomic framework considered for the purpose of our investigation. The log-linear inter-temporal relations take the following form:

$$\pi_t = \alpha E_t(\pi_{t+1}) + (1-\alpha)\pi_{t-1} + \lambda y_t + \varepsilon_t^{\pi} \tag{4}$$

$$y_t = \delta E_t(y_{t+1}) + (1-\delta)y_{t-1} + \sigma\left(i_t - E_t(\pi_{t+1})\right) + \varphi b_t + \varepsilon_t^{y} \tag{5}$$

$$i_t = \beta_i i_{t-1} + \beta_\pi \pi_t + \beta_y y_t + \beta_b b_t \tag{6}$$

where π_t, y_t and i_t represent respectively the inflation rate, the output gap, and the short term nominal interest rate under the central bank's control.[75] The εs are exogenous shocks normally distributed, and E_t denotes the expectation operator. α, λ, δ, σ, φ, β_i, β_π, β_y, and β_b are the model's parameters.

The model consists of a hybrid new Keynesian Phillips curve (equation (4)) where current inflation is affected by both past and expected inflation, and by the current level of output gap. The hybrid IS curve (equation (5)) describes the current output gap as a function of its lagged and expected values, and of the real interest rate. This equation differs from the conventional hybrid IS curve in the presence of the bubble term. It is assumed that the output gap is positively affected by the asset price bubble. As argued in Filardo (2004), the fundamental component of asset prices does not really matter for output or its components. Conversely, the asset price bubble (the non-fundamental component) can affect the aggregate demand by distorting economic decisions and generates changes in consumption through a

[75] Strictly speaking, these are deviations from steady states.

wealth effect, changes in investment via the cost of capital, and changes in government spending through the tax channel.[76]

Finally, equation (6) represents the central bank's reaction function. The monetary policy instrument is set in response to deviations of inflation from its target, the output gap, as well as deviations of asset prices from their fundamental value (the bubble). Moreover, a smoothing component is included in order to limit interest rate volatility. The central bank's reaction function portrays an augmented Taylor rule with a financial variable, suggesting a leaning against the wind policy. Such a policy has been advocated in recent discussions on the monetary policy stance among both academics and practitioners. The objective is to reinforce financial stability by reacting to increasing and unsustainable asset prices which can culminate in a financial crisis with significant real economic effects. However, as we argue in the introduction of this chapter, the central bank's efficiency in achieving its primary objectives can be affected in such a framework.

II.1.c. Model solution and calibration

To solve the model described by the four equations presented above, we rely on the Blanchard-Kahn method (Blanchard and Kahn, 1980). This is a commonly used approach in the literature. However, the specification of the bubble equation gives our model a structure which is less standard. The model is characterized by two states of the nature: the case where the bubble persists (*D* is equal to 1 in equation (3)), and the case where the bubble bursts (*D* is equal to 0 in equation (3)). In this respect, the model is solved for these two states of nature and each period of time, we switch between the two states depending on the value of *D*, which in turn depends on whether the lasting probability of the bubble is above or below the threshold, $\bar{q}$.[77]

[76] Even though the presence of the bubble in the aggregate demand equation has no microfoundations, the above arguments are more in favor of including the bubble in the IS curve rather than in the Phillips curve. Note however that, given the model specification, and more precisely, the fact that the aggregate demand enters the Phillips curve, asset price bubbles also affect aggregate supply, although indirectly.

[77] When the dummy is equal to 0, the Blanchard-Kahn conditions are verified, therefore the model is stable. When *D* is equal to 1, the model is unstable due to the way in which the bubble's equation is specified. However, on the long run the economy converges in probability to the steady state.

As regard the calibration of the model, the parameters for the standard new Keynesian equations are taken from the estimated model of Smets (2000) and correspond to annual data for the euro area. Two other (non-standard) parameters are introduced in our model, namely γ and φ. As no estimation for these parameters exists in the literature, we set their values relying on some ad-hoc assumptions,[78] and we check the robustness of our main conclusions to changes in the values of these parameters. Appendix table IV.1 presents the baseline values of the parameters used to perform the simulations.

II.2. Results

The framework depicted in the reduced-form model characterized by equations (3), (4), (5), and (6) is used to investigate the existence of a trade-off between macroeconomic (inflation and/or output) stability and financial stability, when the central bank reacts to a financial variable. We rely on a simple procedure which can be summarized as follows: the economy is hit by exogenous shocks (supply and/or bubble shocks) which are assumed to randomly occur each period of time.[79] Central banks respond to these shocks by setting the short term interest rate more or less aggressively. Given the aggressiveness of this response, we generate series of variances, calculated on 1000 periods, for each argument of the central bank's reaction function (inflation, output gap and bubble). We compare the evolution of these variances to assess the monetary policy efficiency in achieving its objectives.

Confronted with the same shocks, central banks may react differently, both in terms of measures undertaken and in terms of intensity (or aggressiveness) of the policy. For example, faced with an asset price bubble shock, a central bank may decide to react indirectly through a stronger response to the output gap (since the bubble affects the aggregate demand), thus increasing β_y. Another central bank may rather react directly by strengthening its response to the bubble, increasing β_b. Moreover, in both cases, the responses may be more or less aggressive (a sharp or a more progressive increase in β). For each type of shock and each value of the βs, we generate the corresponding variances of π, y and b. We represent these

[78] It is assumed that the effect of the interest rate on the bubble is of the same magnitude as the effect of the real interest rate on the output gap. It is also assumed that the asset price bubble affects the aggregate demand to a lesser extent than the real interest rate.

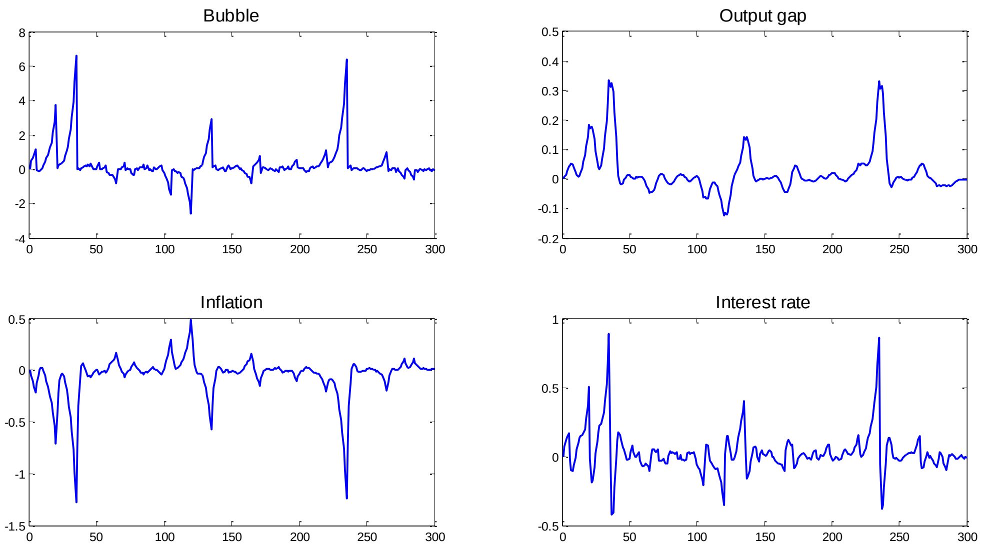
[79] The shocks and the probability q_t are set according to a random process, following a normal and a uniform distribution, respectively.

variances (in pairs) on graphs, in the spirit of a Taylor-type curve, in order to investigate potential trade-offs.

The analysis conducted here should not be view as an attempt to derive the optimal monetary policy stance. The purpose is much more modest and simply aims at investigating, through a comparative-static-type approach, the challenges central banks may face when reacting to financial imbalances. More precisely, we focus on trade-offs between policy objectives. In addition, the differences in parameters in the central bank's reaction function can be viewed as responses from different central banks to the same shocks, and not necessarily as changes in a single central banks response over time.

The main results are discussed considering successively the central banks responses to each type of shock: supply shocks, bubble shocks and a combination of the two.

Figure IV.1.1: Model's response to the bubble shocks (deviations from the steady-state)



The response of the variables (output gap, inflation and interest rate) to consecutive bubble shocks

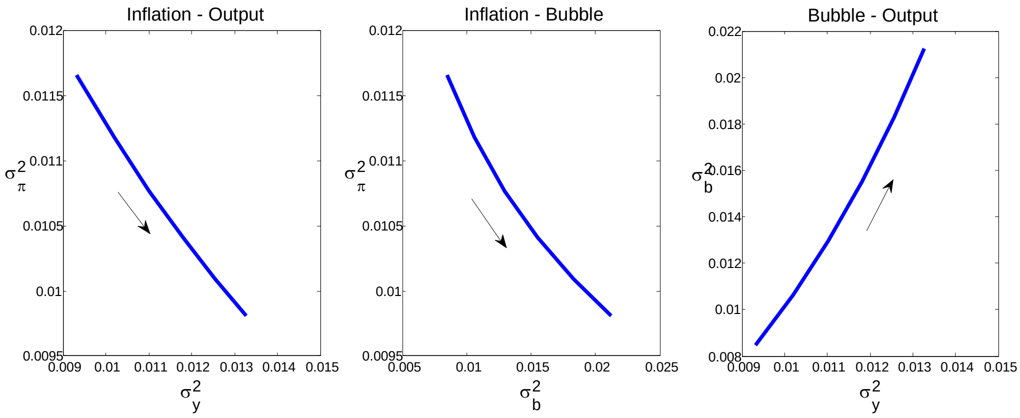
Before addressing the issue of trade-offs, we investigate the response of the model to bubble shocks, by looking at how the output gap, inflation and the interest rate react to deviations of the asset price from its fundamentals (figure IV.1.1). In response to positive bubble shocks, the output gap increases as expected. Given the policy rule, the short term interest rate rises in reaction to higher output gap, but also in response to the bubble. The higher level of the policy rate reduces inflation in the economy with respect to its steady state value.

We turn now to the investigation of potential trade-offs between central banks' objectives when responding to real or financial shocks.

Supply shocks

Faced with positive supply shocks, central banks may respond by tightening monetary policy (increase in β_π). In figure IV.1.2, a stronger response to inflation shocks results in better inflation stabilization, but at the cost of higher output and bubble volatility. The standard trade-off between inflation and output stabilization in a context of supply shocks emerges. Figure IV.1.2 also suggests that there is a trade-off between the stabilization of inflation and the asset price bubble. This implies that the stronger the central bank's reaction to inflation shocks, the higher the asset price bubble volatility. This finding is in line with the argumentation in De Grauwe and Gros (2009) and King (2012). In addition, there seems to be no trade-off between the output gap and the asset price bubble in case of cost push shocks, as the two variances evolve in the same direction.

<u>Figure IV.1.2</u>: Supply shocks (response to inflation)



Variances of inflation, output gap and the bubble following supply shocks. The response to inflation varies between 1.5 and 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

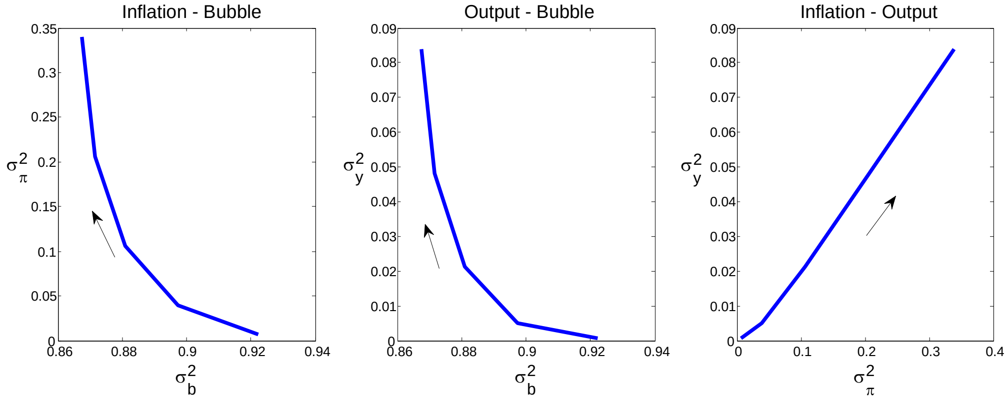
Asset price bubble shocks

Since the asset price bubble enters the central bank's reaction function, the short term interest rate rises in response to positive bubble shocks. This type of reaction, intended to strengthen financial market stability, corresponds to the leaning against the wind strategy. The intensity of the central bank's response to the bubble (the aggressiveness of the leaning strategy) is captured by the value of the parameter β_b. Being more aggressive to the bubble (increase in β_b) indeed reduces the bubble volatility, as shown in figure IV.1.3. However, this better financial market stabilization is achieved at the cost of higher macroeconomic instability, since both inflation and output volatilities increase. These results suggest that a direct central bank's response to financial imbalances may be harmful for the monetary authorities' primary objectives. While such a strategy may be effective in containing a financial bubble, it leads to a deterioration of the macroeconomic stance, generating a trade-off between this main monetary policy objective and the concern for financial stability.

Alternatively, the central bank may choose to react indirectly to bubble shocks through a stronger response to output gap (increase in β_y), since it is assumed that the bubble positively affects aggregate demand. This approach seems to provide a better outcome than the former as it reduces not only the bubble, but also the output gap volatility. However, inflation volatility increases (recall that both output and inflation volatilities increase with the former central bank's response), making this strategy questionable. As a result of the central bank's actions, a trade-off between inflation and financial stability emerges, but the bubble and the output gap seem to be better stabilized (figure IV.1.4).[80] Another important remark regarding the results presented in figure IV.1.4 is that the levels of all the variances are significantly lower (suggesting lower volatilities), compared to the previous strategy. To some extent, this result suggests that a standard Taylor rule provides a better outcome than a pure leaning against the wind strategy, even when facing financial shocks. Although not satisfactory, the standard rule seems to be less costly.

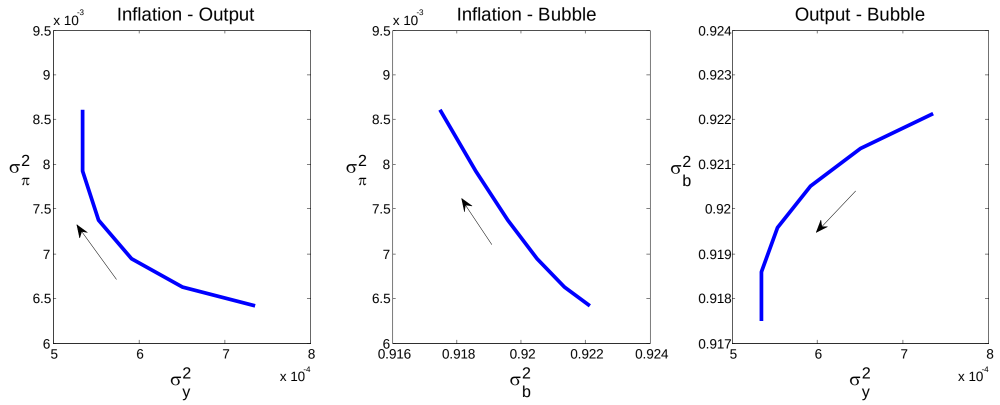
[80] Figure IV.1.4 also shows that there is a trade-off between inflation and the output gap. Such a trade-off is not to be expected in the context of demand shocks in standard models. Note however that our model is different from the standard new Keynesian one, in the sense that it includes a bubble process which is assumed to affect aggregate demand. When removing this assumption, we reach the common conclusion of no trade-off between inflation and output.

Figure IV.1.3: Bubble shocks (response to the bubble)



Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

Figure IV.1.4: Bubble shocks (response to the output gap)

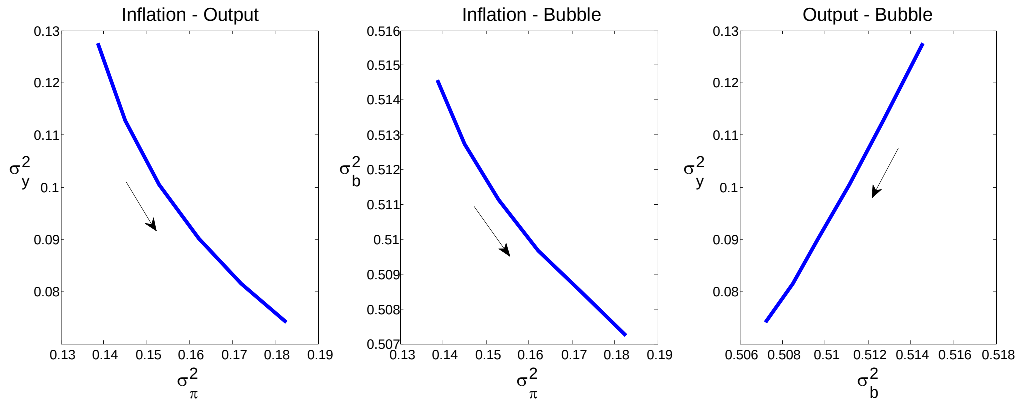


Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Supply and assets price bubble shocks

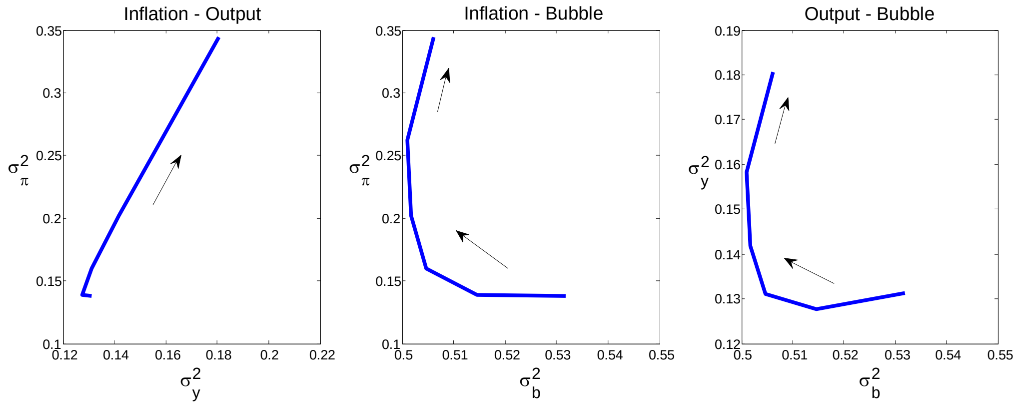
We assume now that the economy is faced with supply and bubble shocks which occur at the same time. The results in this scenario are in line with the above discussion. A stronger response to output gap results in better bubble and output gap stabilization, while inflation variability increases, as shown in figure IV.1.5. There is a trade-off between inflation and bubble stability, but also between aggregate price level stability and output gap stability.

Figure IV.1.5: Supply and bubble shocks (response to output gap)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.1.6: Supply and bubble shocks (response to the bubble)

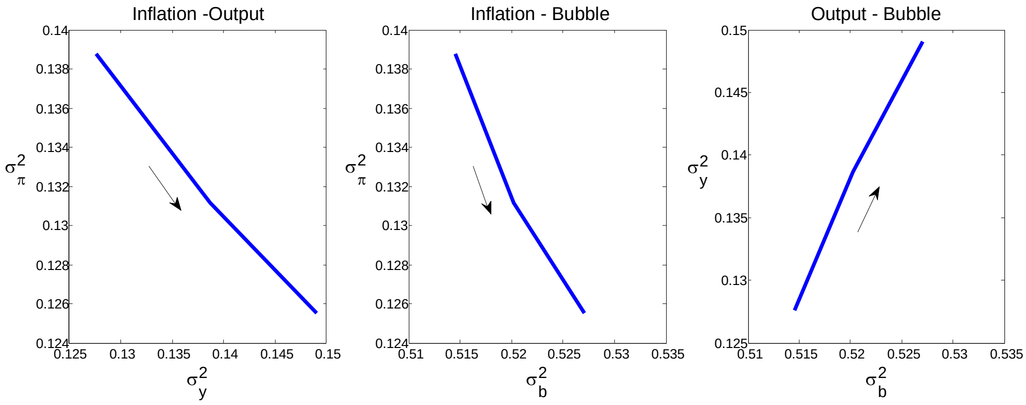


Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

If the monetary authorities are more adverse to financial instability and strengthen their response to the bubble (increase in β_b), the bubble's variability decreases, whereas inflation and output volatilities increase. The results in figure IV.1.6 also show that, in a later stage, when the central bank's reaction becomes more aggressive, all policy objectives are negatively affected (increase in output, inflation and bubble volatilities). In other words, when the central bank's response to the bubble exceeds a certain threshold, the effect on the economy becomes counterproductive, leading not only to a deterioration of the macroeconomic stability, but also to an increase in the bubble's volatility. This finding is in line with Gali (2014) who argues that increasing the interest rate in response to a growing bubble generates higher fluctuations in the latter, as the interest rate positively affects the bubble's growth. In a different framework with another definition for financial instability, Svensson (2013) also concludes to a counterproductive effect of tightening monetary policy to stabilize the financial system.[81] Note that the levels of the variances are also higher in this case, compared to a strategy in which the central bank responds to the output gap.

In response to supply and bubble shocks, an increase in the reaction to inflation lowers its volatility, while there is an increase in output gap and bubble volatilities (figure IV.1.7). A trade-off between inflation and bubble stability emerges, in addition to the standard inflation - output gap trade-off.

Figure IV.1.7: Supply and bubble shocks (response to inflation)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

Generally, these results seem all to be against the leaning against the wind strategy. Regardless of the type of shock, a trade-off between inflation stability and financial stability is always present. At best, responding to the bubble by increasing β_b improves financial stability, but endangers the main objectives of the central bank, as in this scenario both inflation and output volatilities increase. The best outcome, although not ideal, is to increase the response of the policy rate to the output gap. This allows the monetary authorities to

[81] Considering household indebtedness as an indicator of financial instability, Svensson (2013) shows that a tighter monetary policy to control the level of debt leads to an increase in the debt to GDP ratio. Tightening monetary policy more than necessary for inflation stabilization will raise the real household debt and dampen the nominal GDP, increasing the debt to GDP ratio and so financial instability.

improve both financial and output gap stability; but the price stability objective is left aside in this case. Several authors (De Grauwe and Gros, 2009; Woodford, 2012) now seem in favor of this strategy, where the central bank neglects its main objective in the short run, in order to avoid or to contain the harmful effects of a financial bubble.

II.3. Robustness checks

To check the robustness of our results, various analyses are conducted. First, the bubble is assumed to be affected by the levels of the short term interest rate rather than the changes. Second, we assess the extent to which our results are sensitive to changes in the values of the parameters φ and γ. Third, we examine different random selections for supply and financial shocks. And finally, an alternative random selection of the probability q_t is considered.

Bubble affected by levels rather than changes in interest rate

In section II.1.a, it is assumed that changes in the short term interest rate matter more for the financial sector than levels. However, it can be argued that the levels of the policy rate also matter since they can have important effects on the private sector's risk taking behavior. We assess the extent to which our main results remain relevant if the bubble is affected by levels of the short term interest rate rather than its changes (in equation (2), Δi_{t-1} is replaced by i_{t-1}). With such a framework, our findings are the same as in the baseline model when supply shocks are considered. We also reach the same conclusions regarding bubble shocks. When the central bank responds to the bubble, a trade-off emerges between macroeconomic and financial stability. An indirect reaction through a response to the output gap produces a better outcome, as in the baseline analysis. When the economy is hit by the two shocks simultaneously, responding to the output gap and inflation produces the same effects found in section II.2. The response to the bubble generates a trade-off between inflation and the bubble stabilization, but also between output gap and bubble stability. Overall, considering the levels of the policy rate does not change our conclusions highlighting the existence of trade-offs (appendix figure IV.1).

Robustness to different values of the parameters φ and γ

For robustness to parameters' values, we focus on the trade-off between inflation and bubble stabilization. Indeed, our main conclusions so far suggest that this trade-off always emerges, regardless of the nature of the shock and of the central bank's reaction.

In a context of asset price bubble shocks and with the central bank responding either directly to the bubble or indirectly, through a response to the output gap, we investigate the existence of this trade-off for different values of φ (between 0.01 and 0.025). The results presented in appendix figure IV.2 show that whatever the value of φ considered, there is always a trade-off between inflation and financial stability.

The same investigation is conducted for different values of γ (with γ taking values between 0.02 and 0.07). The economy is hit by asset price bubble shocks and the central bank responds to the bubble or to the output gap. The findings are in line with our previous conclusions that there is always a trade-off between inflation and bubble stability (appendix figure IV.3).

Robustness to an alternative selection of shocks

As discussed earlier, the shocks are drawn on a random basis from a normal distribution. We perform a robustness check by considering another random selection of shocks and we conduct the same analysis as above. Regarding the responses to supply shocks, the findings are the same as in the baseline model. We also reach the same conclusions when the central bank reacts to bubble shocks. There is a trade-off between macroeconomic (inflation and output) stability and financial stability (although small and limited policy rate adjustments seem to succeed in reducing bubble and output volatilities). When the central bank is faced with the combination of the two shocks, the results are also in line with the baseline model. A response to the bubble, while decreasing the bubble volatility, raises both inflation and output variability. A response to output gap lowers output and bubble instability, but generates a greater variability of inflation. Finally, a response to inflation leads to the inflation - output trade-off, but also to an inflation - bubble trade-off (appendix figure IV.4).

Robustness to an alternative selection of q_t

The values of q_t are selected randomly following a uniform distribution. To further check the robustness of our results, we also draw an alternative series of q_t following the same process and we conduct the same analysis. The findings regarding supply shocks are the same as in the baseline model. For bubble shocks, in first stage, tighten the monetary policy by increasing the response to the bubble lowers the bubble's volatility, but at the cost of higher output gap and inflation volatility. However, in a later stage, when the response is more aggressive, all three volatilities increase, leading to a deterioration of macroeconomic, as well as financial stability. Central banks which respond strongly to output gap in the context of bubble shocks seem to perform better, although not satisfactorily. As in the baseline model, the bubble and output volatilities decline, while inflation volatility rises. Considering the combination of the two shocks, a monetary authorities' response to the bubble reduces the bubble and the output gap volatilities at first, but worsens macroeconomic and financial stability later on, when this response is stronger. The responses to the output gap and inflation reveal the same outcome as in the baseline model (appendix figure IV.5).

Overall, the alternative analyses conducted in this section highlight the robustness of our main results. A policy framework in which central bank responds directly and more aggressively to financial instability is subject to trade-offs between the primary inflation (and output) stabilization objective and financial stability.

In summary, the purpose of the first analysis conducted in this chapter is to explore the extent to which trade-offs can emerge between macroeconomic and financial stability when the central bank is directly concerned with financial imbalances. Various forms of central bank's responses and the strength of these responses are assessed when the economy is confronted with different shocks. The main conclusion of the analysis is that, central banks practicing the leaning against the wind strategy will face trade-offs between traditional macroeconomic objectives (inflation and output stabilization) and financial stability. More precisely, when the central bank responds to financial imbalances, in the best-case scenario, such a policy can succeed in dampening financial risks, but at the cost of higher aggregate price instability. Our results also seem to highlight the worse-case scenario in which the policy is counterproductive with respect to all the monetary policy objectives (increase in macroeconomic and financial instability).

While the leaning against the wind strategy may be required, especially since the global financial crisis unfolded, this analysis argues that such a policy can lead to trade-offs between objectives. Monetary authorities can face a challenge in achieving their objectives if monetary policy explicitly responds to financial imbalances. A second instrument is needed to tackle this issue. Whereas central banks should continue to focus on the traditional macroeconomic goals, a prudential framework should be developed to address the particular issue of financial instability. The recent debate also argues in favor of such framework in which a separate prudential instrument should be explicitly devoted to the control of financial risks; the short interest rate remaining the main instrument for macroeconomic stabilization. Particularly, following the new Basel III recommendations, macroprudential policies aiming at controlling the system-wide financial risks seem to be required. In the second analysis conducted in this chapter, we investigate the extent to which a framework that incorporates such a prudential instrument may provide better policy outcomes, both in terms of trade-offs between objectives and in terms of stabilization of the overall economy.

III. Extended model with macroprudential policy

We now set up a second analytical framework which introduces a prudential instrument with the purpose to control financial imbalances which may endanger the financial system. Particularly, we introduce a banking sector which supplies credit to the economy and we assume that the loan supply contributes in fuelling the financial bubble, generating higher financial instability. This assumption is supported by the existing literature suggesting that financial bubbles are commonly preceded or accompanied with rapid credit growth or excessive credit supply. In this respect, it is argued that controlling the loan supply in the economy may help to avoid or contain financial bubbles, and ultimately, prevent financial crises.

It should be worth noting that the framework described in this analysis discards the issue of institutional arrangement which may guide the implementation of monetary and prudential policies. Monetary policy is implemented by the central bank (or the monetary authority) as discussed in the previous section. We do not explicitly define the institution in charge of the implementation of the prudential policy. As discussed in the first chapter, various possible institutional configurations exist in setting up both monetary and prudential frameworks. Our analysis rather focuses on assessing the effectiveness of alternative strategies which may be implemented in response to financial shocks. Particularly, we investigate the extent which supplementing the (simple) theoretical model described above with a macroprudential instrument may improve the policy outcome, not only in terms of trade-offs between objectives, but also in terms of both macroeconomic and financial stabilization.

In what follows, first, we introduce the new theoretical framework. Especially, we describe the banking sector and its interaction with the aggregate demand, and we set up the prudential instrument. We discuss how the financial bubble is affected by the banking sector activity, through credit supply. Second, we proceed with the investigation of various strategies which may be implemented to cope with shocks and we discuss the simulations' results. Finally, the main results are summarized and a comparative analysis of the strategies' outcome is conducted.

III.1. The model

This section describes the theoretical framework used to investigate various strategies that may be employed to deal with financial stability concerns. The standard three-equation new Keynesian model (as described in section II) is supplemented with two other equations capturing the supply of domestic credit (bank loans), on the one hand, and an asset price bubble describing risk accumulation in the financial market, on the other hand. First, we present the banking sector and the aggregate demand equations, next the bubble equation, and finally the overall macroeconomic framework.

III.1.a. The aggregate demand and the banking sector

The simultaneous introduction of equations describing the aggregate demand and the banking sector allow discussing how the prudential instrument (fixed or countercyclical minimum capital requirements for banks) affects the credit supply and the aggregate demand. The framework described here is inspired by Bernanke and Blinder (1988), Cecchetti and Li (2008) and Nakornthab and Rungcharoenkitkul (2010).

$$y_t = \delta E_t(y_{t+1}) + (1-\delta)y_{t-1} + \sigma\left(i_t - E_t(\pi_{t+1})\right) + \upsilon\left(i_t^c - E_t(\pi_{t+1})\right) + \varphi b_t + \varepsilon_t^y, \quad \upsilon, \sigma < 0 \qquad (7)$$

Equation (7) represents the new formulation of the hybrid IS curve capturing the aggregate demand. i_t^c is the nominal lending rate. This formulation differs from the specification in equation (5) in the sense that the output gap also depends on the real lending rate, stressing the connection between the real and the financial sector.

$$c_t^d = c_y y_t - c_i\left(i_t^c - E_t(\pi_{t+1})\right), \quad c_y, c_i > 0 \qquad (8)$$

$$c_t^s = (1-\frac{N}{C})d_t + \frac{N}{C}n_t \qquad (9)$$

$$d_t = d_y y_t - d_i\left(i_t - E_t(\pi_{t+1})\right), \quad d_y, d_i > 0 \qquad (10)$$

$$n_t = n_y y_t, \quad n_y > 0 \qquad (11)$$

Equations (8) to (11) describe the banking sector. c_t^d is the real loan demand, c_t^s the real loan supply, d_t the real deposit, n_t the real bank capital. The uppercase letters N and C describe the steady-state values of n and c, respectively. Lower case letters with time subscripts stand for log-deviations of variables from steady-states. It is assumed that the real loan demand increases with the economic activity, but decreases with the real lending rate (equation (8)). The loan supply equation (equation (9)) results from the log-linear transformation of the bank balance sheet identity $C_t = D_t + N_t$ (where C_t, D_t and N_t stand for credit, deposits and bank capital in aggregate form, respectively). The real bank deposit is assumed to be a positive function of the economic activity and a negative function of the real policy rate (equation (10)).[82] Finally, the real bank capital is assumed to increase only with the output gap (equation (11)).

At the market equilibrium, equalizing credit demand and credit supply, and substituting the deposit and bank capital equations into the resulting equilibrium relation yields the following expression of the real lending rate.

[82] Deposits are not remunerated and the real interest rate therefore represents an opportunity cost.

$$\left(i_t^c - E_t(\pi_{t+1})\right) = \left[\frac{c_y}{c_i} - (1-\frac{N}{C})\frac{d_y}{c_i} - \frac{N}{C}\frac{n_y}{c_i}\right] y_t + (1-\frac{N}{C})\frac{d_i}{c_i}\left(i_t - E_t(\pi_{t+1})\right)$$

Substituting this expression of the real lending rate into the aggregate demand equation yields

$$\omega^u y_t = \delta E_t(y_{t+1}) + (1-\delta) y_{t-1} + (\sigma + \kappa)\left(i_t - E_t(\pi_{t+1})\right) + \varphi b_t + \varepsilon_t^y \qquad (7')$$

where $\omega^u = 1 + \frac{\upsilon}{c_i}\left[(1-\frac{N}{C})d_y + \frac{N}{C}n_y - c_y\right]$ and $\kappa = \frac{\upsilon}{c_i}(1-\frac{N}{C})d_i < 0$

Equation (7') therefore gives the expression of the aggregate demand when the regulator does not constrain the banking sector by imposing a minimum capital requirement. The superscript "*u*" indicates that this is the *unconstrained* case.

For the purpose of investigating the implications of a countercyclical bank capital regulation on the macroeconomic and financial system, let us assume that banks are constrained by the following minimum capital requirement:

$$N_t \geq \left[e + \frac{1}{\mu_1}\left(\frac{Y_t}{Y}\right)^{\mu_2}\right] C_t \qquad (12)$$

where Y_t and Y stand for the output and its steady state respectively, e and μ_1 are positive constants, and $\mu_2 \geq 0$. With this simple formalization, we intend to mimic the Basel III regulatory standard on banks' capital adequacy introduced in the aftermath of the late 2000s global financial crisis. The constant parameter e can indeed be thought as the sum of the (fixed) minimum capital ratio and the capital conservation buffer. The term in brackets captures the countercyclical part of the bank capital buffer. This countercyclical part of the bank capital regulation intends to expand the capital buffer to take account of changes in the perceived system-wide risk. The purpose is typically to increase the buildup of capital conservation buffers in period of high financial risks (during booms) in order for banks to be able to cope with associated potentially high losses if the risk materializes. We follow Nakornthab and Rungcharoenkitkul (2010) and rely on the output as the conditional variable for the countercyclical part of the capital regulation. The output deviations from the steady state are expected to capture the economic cycle and the related potential risk for the financial sector which may require adjustments in the bank capital buffer. Angeloni and Faia (2009) also rely on a similar framework to mimic the countercyclicality of the bank capital requirements.

In our analysis, the case where μ_2 = 0 will be referred to as the *fixed capital requirements* regulatory system, and the case where μ_2 > 0 will stand for the *countercyclical capital requirements* regime.

The log-linear transformation of equation (12) yields the above new expression of the credit supply:

$$c_t^s = n_t - \frac{\mu_2}{\mu_1 e + 1} y_t \tag{13}$$

Equalizing equation (13) with the credit demand (equation (8)) and following the same simplifications and substitutions as above, we can derived the following expression of the aggregate demand:

$$\omega^c y_t = \delta E_t(y_{t+1}) + (1-\delta) y_{t-1} + \sigma\left(i_t - E_t(\pi_{t+1})\right) + \varphi b_t + \varepsilon_t^y \tag{7''}$$

where $\omega^c = 1 - \frac{\upsilon}{c_i}(n_y - c_y - \frac{\mu_2}{\mu_1 e + 1})$. Equation (7'') provides the expression of the aggregate demand when the banking sector is constrained by the prudential regulation. The superscript "*c*" here denotes the *constrained* case which encompasses the fixed capital requirements case (μ_2 = 0) and the countercyclical capital requirements case (μ_2 > 0).

III.1.b. The bubble equation

The recent financial crisis further emphasizes that asset price bubbles are often preceded by, or accompanied with credit booms. Particularly, the housing price bubble that culminated in a crisis in the late 2000s was associated with an increase in bank loans (especially mortgage loans). The literature has also largely documented this positive correlation between asset price bubbles and excessive bank credit. Indeed, empirical researches have evidenced that asset price inflation is usually preceded by an increase in domestic credit, making the latter a good forward indicator to detect asset price booms. The related literature for industrialized economies includes Helbling and Terrones (2003) who show that booms in equity price are generally associated with a large increase in corporate borrowing and investments which reflect strong domestic demand. Assessing asset price booms, Detken and Smets (2004) differentiate between low- and high-cost booms (asset price booms which are followed by more moderate or high output losses, respectively) in OECD countries. They find that during boom periods, high-cost booms are characterized (among other factors) by large increase in real credit growth. Machado and Sousa (2006) rely on non-parametric quantile regressions as a methodology to detect asset price booms and busts. Using data for the euro area private sector, they evidence that asset price booms occur either during period of sharp increase in real loan growth, or after long periods of increase in real loan. Gerdesmeier et al. (2010) construct a composite indicator of asset price that incorporates information on both stock price and house price markets, for a sample of OECD countries. Their empirical investigations show that credit aggregates (changes or growth gap in credit) are among the best indicators that help forecast asset price busts.

This relation between asset price bubbles and credit also seems to be relevant in emerging countries, as suggested by Collyns and Senadji (2002) who show that asset price inflations are strongly and positively correlated with bank loans in East Asia. Analyzing the link between bank lending and the real estate market in Asia, Koh et al. (2005) provide evidence that the expansion of the real estate price in past boom periods has been mostly driven by a sharp increase in bank lending. For example, it is argued that in Malaysia, between 1992 and 1996 more than 70% of bank lending was channeled into real estate or stock market investments.

To take account of this relation between financial bubbles and domestic credit, we assume that the bubble process can be affected by the bank loan. Especially, loan supply is assumed to be positively correlated with the asset price bubble as follows:

$$b_t = \left[\frac{1+\bar{i}}{\bar{q}} (b_{t-1} + \gamma \Delta i_{t-1} + \phi c^s_{t-1}) \right] D + \varepsilon^b_t \tag{14}$$

where D, as in the first specification, is a dummy variable which takes the value of 1 as long as the bubble lasts, and 0 when it bursts.

III.1.c. The new macroeconomic framework

The macroeconomic framework is now described by the following set of equations:

$$\pi_t = \alpha E_t(\pi_{t+1}) + (1-\alpha)\pi_{t-1} + \lambda y_t + \varepsilon_t^{\pi} \quad (4)$$

$$\omega^{u,c} y_t = \delta E_t(y_{t+1}) + (1-\delta) y_{t-1} + (\sigma+\kappa)\left(i_t - E_t(\pi_{t+1})\right) + \varphi b_t + \varepsilon_t^{y} \quad (7''')$$

$$i_t = \beta_i i_{t-1} + \beta_\pi \pi_t + \beta_y y_t + \beta_b b_t \quad (6)$$

$$c_t^s = \left[(1-\frac{N}{C})d_y + \frac{N}{C}n_y\right] y_t - (1-\frac{N}{C})d_i\left(i_t - E_t(\pi_{t+1})\right) \quad (9')$$

Equation (7’’’) is the hybrid IS curve as describe above, which can take alternatively the expression of equation (7’) in the *unconstrained* case, or the expression of equation (7’’) in the *constrained* case (with $\kappa = 0$). Substituting the expressions of d_t and n_t into equation (9) gives the new expression of the credit supply provided in equation (9’). The bank loan supply depends on the output gap and the real short term interest rate. The above set of four equations is supplemented with the bubble equation (equation (14)), and together form the new theoretical framework on which we rely for the purpose of our analysis.

The reduced-form model describes by equations (4), (6), (7’’’), (9), and (14) is used to investigate various central bank’s and prudential policy strategies to deal with financial shocks, and the relative performances of those strategies in achieving both macroeconomic (inflation and output gap) and financial stability. Our approach is based on a procedure similar to what has been implemented in section II, and can be summarized as follows: it is assumed that each period of time the economy is hit by random exogenous shocks (supply and/or bubble shocks). In response to those shocks, two main response strategies are considered. First, a response through the sole monetary policy instrument, considering that the banking sector is unconstrained (there is no prudential policy). Second, we consider the case where the prudential instrument is implemented and is potentially complemented with central bank’s responses through the policy rate. These central bank’s responses imply setting the short term interest rate more or less aggressively to mitigate the shock.

Focusing on the monetary authority interventions, as in our previous analysis, the central bank's reaction to shocks can occur through a direct response to the bubble (increase in β_b), or can operate indirectly through a response to the output gap (increase in β_y). It is also assumed that these alternative responses can be more or less aggressive (a sharp or more progressive increase in the βs). Regarding the prudential policy, two alternative strategies are also considered. First, a prudential intervention relying on a fixed minimum capital requirement for banks, and second, the case where bank capital requirements adjust with the economic cycle (countercyclical capital requirements). We assess the efficiency of these two prudential strategies in combination with the alternative monetary policy responses.

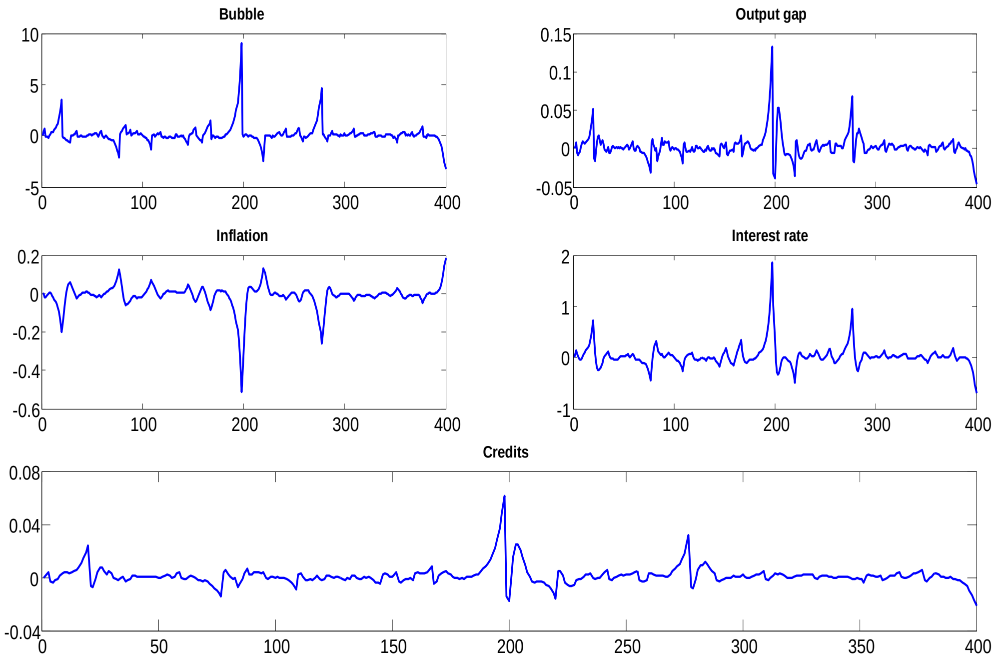
Finally, considering each type of shock and each possible monetary policy and/or prudential policy response, we generate the corresponding series of variances for each argument of the central bank's reaction function (π, y, and b) calculated on 1000 periods. We plot these variances in pairs, in the spirit of what has been done previously. This allows assessing potential trade-offs between the policy objectives. We will also pay a particular attention on levels of the variances, since we are interested in determining the strategy which delivers the best stabilization conditions for the economy (implying lower variances). As for the first analytical framework, this approach should be viewed as a comparative analysis of different policy strategies rather than an attempt to derive optimal monetary and prudential policies stances.

The model is solved with the Blanchard-Kahn method as described previously. The parameters related to the banking sector equation are taken from Nakornthab and Rungcharoenkitkul (2010) and also correspond to annual data for the euro area banking system. For the new parameter ϕ, it is assumed that the magnitude of the effect of credit supply on bubble is higher than the effect of interest rate. The baseline values of the other parameters remain unchanged (see appendix table IV.1).

III.2. Results

The main results are discussed considering first, the case where there is no prudential instruments (banks are unconstrained), and second, the case where the prudential authority sets up a regulatory requirement. For each strategy considered, we assess the response to asset price bubble shocks, and the response to the combination of asset price bubble and supply shocks. Note that in any case, our model reproduces the standard trade-off between inflation and output gap stabilization when supply shocks occur and the central bank responds to inflation. We skip these results to focus on the main purpose of the analysis which is the response to financial shocks.

Figure IV.2.1: Model's responses to bubble shocks (deviations from steady-state)



Response of the main variables to consecutive bubble shocks

Before discussing these results, we look at the main variables' response to consecutive bubble shocks. The scenario in which both macroprudential and monetary policy are used to counteract the financial shocks is considered. Figure IV.2.1 shows that positive bubble shocks positively affect the output gap which in turn determines the loan supply. The central bank responds by tightening the monetary policy stance (increase in the short term interest rate), and this results in a better inflation control. These preliminary simulations evidence positive correlations between output, credit supply and the bubble.

III.2.a. The unconstrained case

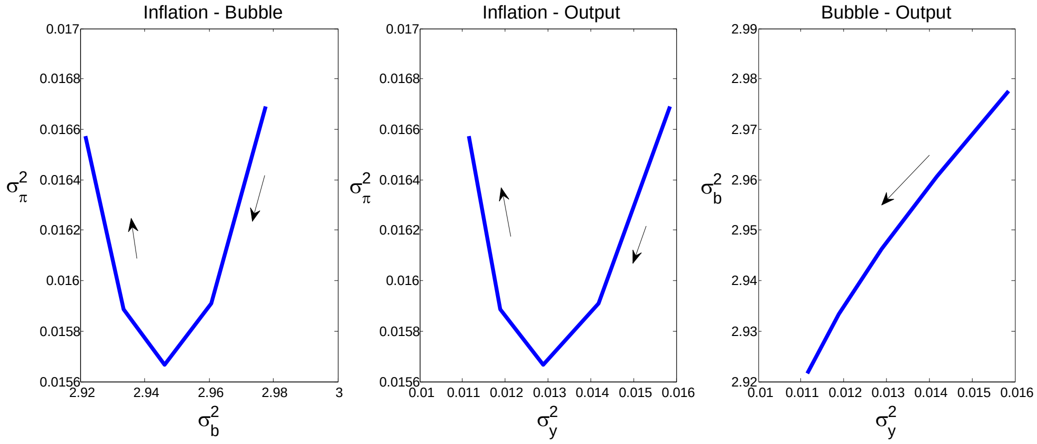
As discussed earlier, the unconstrained case is the policy framework which does not include the prudential instrument and the only responses to shocks occur through the short term interest rate. The central bank can either respond directly to financial shocks (the leaning against the wind strategy) or indirectly through the output gap.

Unconstrained without leaning

It is assumed that the central bank does not react directly to financial imbalances ($\beta_b = 0$), but rather tighten the monetary policy stance in response to the increase in output gap as a consequence of positive asset price bubble (or supply and bubble) shocks. Figure IV.2.2 shows how the variances of π, y, and b evolve with more aggressive central bank response to the output gap (increase in β_y) in case of asset price bubble shocks. In a first stage, the results show that all the variances decrease, suggesting that this strategy produces the desired effect and stabilizes the bubble as well as macroeconomic environment. However, in a later stage, when the central bank's response becomes more aggressive, the bubble volatility continues to decrease but at the cost of higher inflation volatility. In other words, a stronger central bank's response to financial shocks generates a trade-off between the standard inflation stability objective and financial stability.

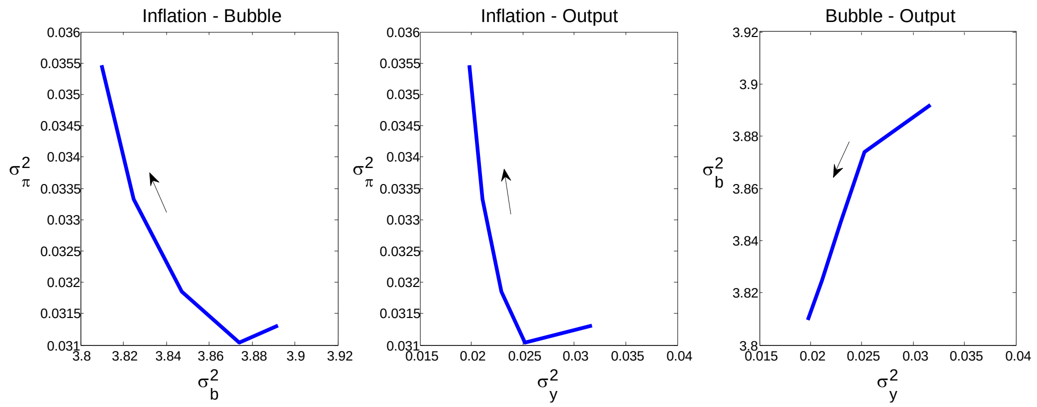
Figure IV.2.3 provides the results for the central bank's response through the output gap in case of supply and asset price bubble shocks. These results are broadly in line with the findings discussed above. Strengthen the interest rate's response to the output gap in case of financial and supply shocks, stabilizes both the financial sector and the macroeconomic environment in a first stage. But when such a response becomes more aggressive, a trade-off emerges between financial stability and inflation stabilization. Note however that in this case, the trade-off shows up with less aggressive response (lower values of β_y), compared to the bubble shocks case.

Figure IV.2.2: Bubble shocks (response to output gap)



Unconstrained case without leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.2.3: Supply and bubble shocks (response to output gap)



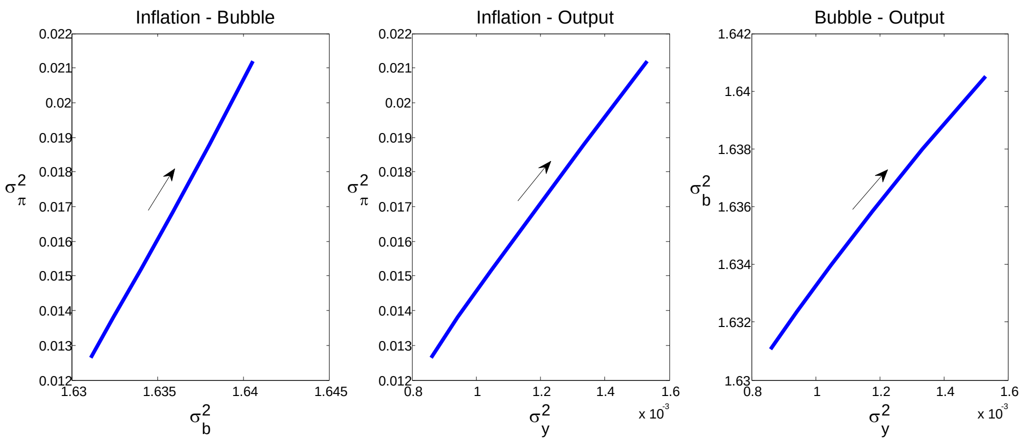
Unconstrained case without leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Unconstrained with leaning

Let us now assume that the central bank follows a leaning against the wind strategy, suggesting that the short term interest rate responds to asset price deviations from the fundamental value ($\beta_b \neq 0$). In this framework, in response to bubble or bubble and supply shocks, two alternative strategies are considered: a direct response to the bubble (increase in β_b) or an indirect response through the output gap (increase in β_y).

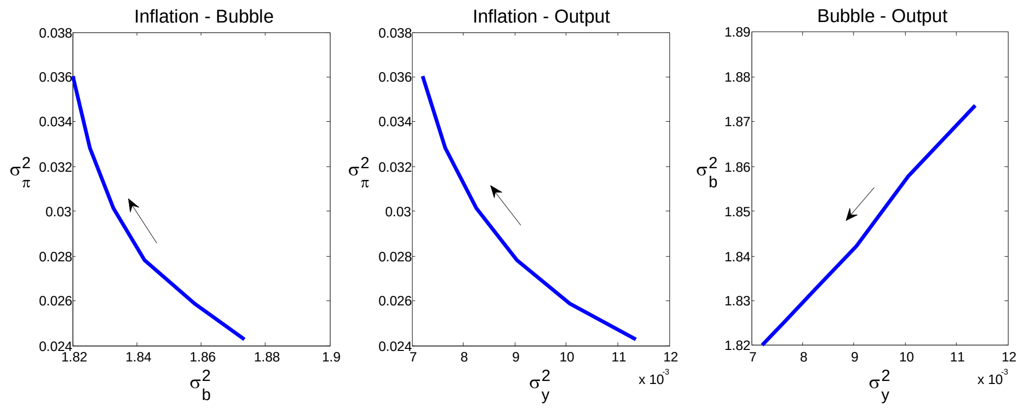
In case of bubble shocks, a response to the output gap generates an increase in volatility for all variables (figure IV.2.4). This suggests that in this framework, such a strategy is counterproductive in the sense that the central bank's action does not stabilize neither the financial sector, nor the macroeconomic environment.

Figure IV.2.4: Bubble shocks (response to output gap)



Unconstrained case with leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.2.5: Supply and bubble shocks (response to output gap)



Unconstrained case with leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

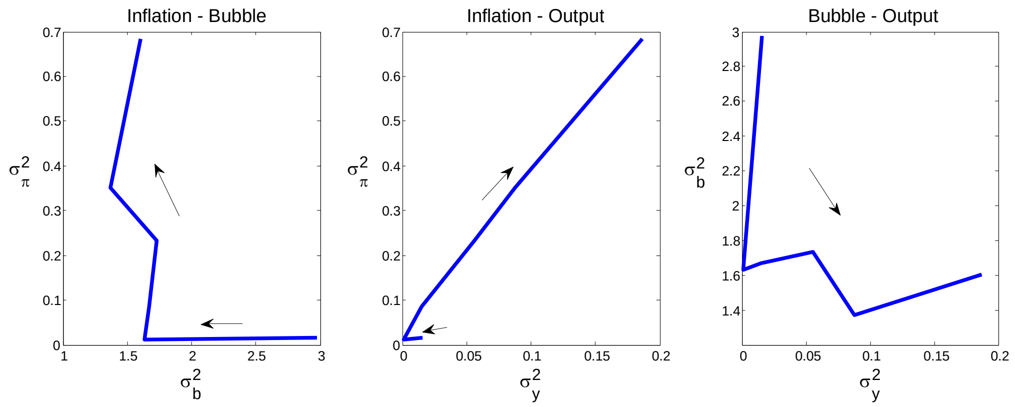
Considering the combination of supply and bubble shocks, a response to the output gap stabilizes the bubble and the output gap (decrease in bubble and output gap volatilities), but generates higher inflation instability (increase the inflation volatility). This strategy is consequently subject to a trade-off between financial stability and inflation stabilization (figure IV.2.5).

An interesting remark however is that, compared to the 'unconstraint without leaning' case, the levels of the bubble volatility are significantly lower (given the same magnitude of the central bank's responses). The levels of the output gap volatility are also significantly lower, while the levels of inflation volatility remain broadly unchanged (see figures IV.2.2 / IV.2.3 compared to figures IV.2.4 / IV.2.5). Based on this latter observation, we can argue that the strategy where the central bank leans against the wind but responds more aggressively to the output gap in case of financial shocks, produces a better (although not satisfactory) outcome.

Let us consider now a direct response to the bubble. The central bank responds by setting the short term interest rate more aggressively (increase in β_b) in response to asset price bubble (or bubble and supply) shocks. Figures IV.2.6 and IV.2.7 show how the variances are affected by such a policy. Broadly speaking, the two figures look alike. The bubble volatility does not seem to describe a clear trend (compared to the other response strategies investigated so far), suggesting higher instability in the financial sector. In addition, the levels of all variances are significantly higher compared to those that result from an indirect response of the central bank through the output gap (see figures IV.2.4 / IV.2.5 compared to figures IV.2.6 / IV.2.7). This suggests that a strategy involving an increase in the policy rate in responses to bubble shocks is not efficient, as it deteriorates the financial sector stability and destabilizes the macroeconomic environment.

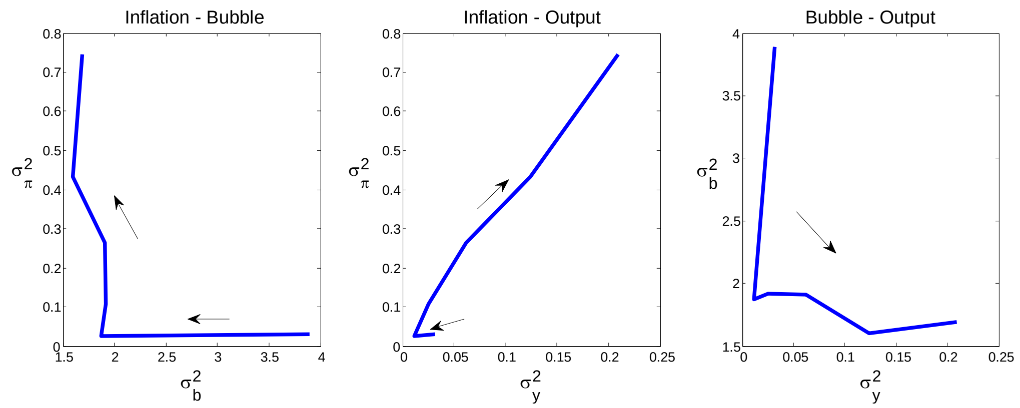
To summarize the findings at this stage of the analysis, our simulations suggest that it may be relevant for monetary policy to take account of financial imbalances when setting the policy rate (include a financial instability indicator in the central bank's reaction function in order to lean against the wind). However, faced with financial shocks, or a combination of financial and supply shocks, which may require a tighter policy, central bank should better react by strengthening the short term interest rate responses to the output gap, rather than increase its response to the bubble. Indeed, the model's simulations evidence that stronger response to bubble generate higher financial as well as macroeconomic instability. These findings are broadly in line with the conclusion derived from the first analysis conducted in section II.

Figure IV.2.6: Bubble shocks (response to the bubble)



Unconstrained case with leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

Figure IV.2.7: Supply and bubble shocks (response to the bubble)



Unconstrained case with leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

III.2.b. The constrained case

We now consider the case where a prudential instrument exists and is used to stabilize the financial sector. In particular, a minimum capital requirement is imposed to banks in order to reduce the loan supply and ultimately contain or deflate the bubble. We further assume that this prudential instrument can be implemented together with a strategy in which the central bank responds to financial risks by setting its policy interest rate. Especially, as discussed earlier, two possible formulations of the prudential instrument are investigated: fixed and countercyclical capital requirements. For each of those two formulations, we will considered the two possible responses of the central bank (direct response through stronger reaction to the bubble, or response through the output gap) to the two alternative types the shocks (assets price bubble shocks, or bubble and supply shocks). First, we assess the performances of the fixed minimum capital requirements case, and next, we turn to the countercyclical capital requirements case.

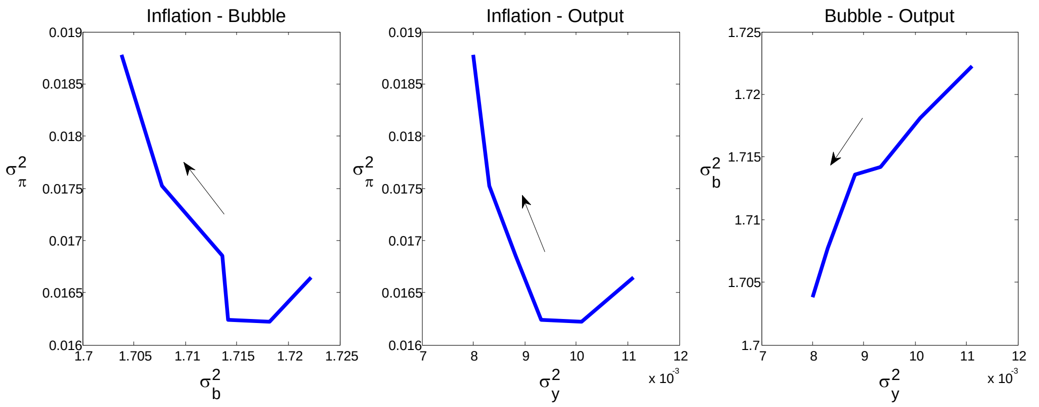
Fixed capital requirements

Let us first assume that since there is prudential instrument, the central bank does not responds directly to financial imbalances ($\beta_b = 0$),[83] but may rather strengthen the policy rate reaction to the output gap in response to shocks (increase in β_y). Figure IV.2.8 shows the stabilization performances of the implementation of fixed capital requirements to banks, in case of asset price bubble shocks. The results suggest that, with fixed minimum capital requirements in place, the central bank response to the output gap improves the financial sector stability (reduction in the bubble volatility) and also reduces the output gap volatility. Note also that in a first stage, the inflation volatility declines, but increase subsequently with stronger interest rate responses to the output gap, generating a trade-off between inflation stability and financial stability.

Figure IV.2.9 provides the results obtained in the same context as above, but when bubble and supply shocks occur simultaneously. The simulations suggest that the central bank response reduces both the bubble and the output gap volatilities, but generates higher inflation instability. A trade-off also emerges in this case between the standard inflation stability objective and financial stability.

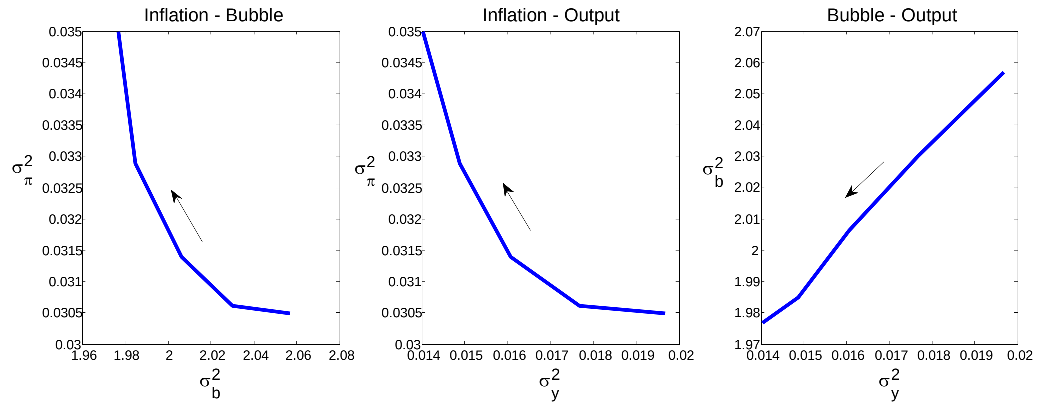
[83] This case reflects a framework in which the two objectives of macroeconomic and financial stability are considered separately. The short term interest rate is devoted to the first objective, while the prudential authority relies on the bank capital requirements to achieve the second one.

Figure IV.2.8: Bubble shocks (response to output gap)



Fixed capital requirements case without leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

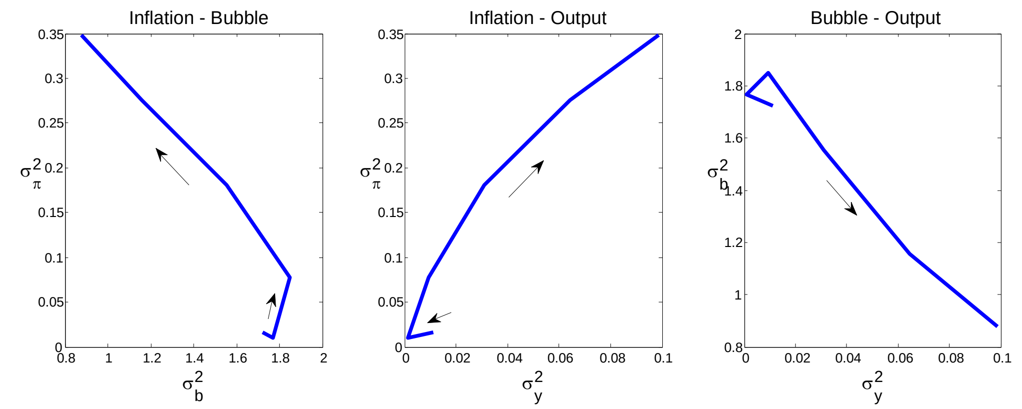
Figure IV.2.9: Supply and bubble shocks (response to output gap)



Fixed capital requirements case without leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

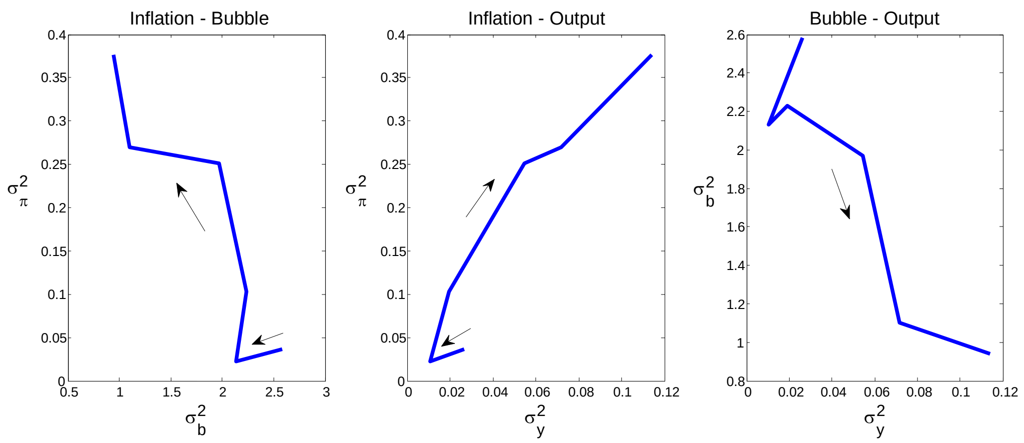
An alternative policy framework to be considered is the case where despites the implementation of the prudential instrument, the central bank is (directly) concerned with financial imbalances when setting its policy rate ($\beta_b \neq 0$). In this framework, let us first investigate what happen if the monetary authority's reaction to asset price deviations becomes more aggressive (increase in β_b). Figures IV.2.10 and IV.2.11 show how such a response affects the variables' volatilities in case of bubble shocks, and bubble and supply shocks, respectively. In line with previous findings, when the central bank responds directly and more aggressively to the bubble, the results suggest that this strategy does not provide a better outcome, compared to the response through the output gap. The financial sector seems to be more unstable, as the bubble volatility is higher. More importantly, the macroeconomic environment is much more volatile, as the variances significantly increase compared to the previous case (see figures IV.2.8 / IV.2.9 compared to figures IV.2.10 / IV.2.11).

Figure IV.2.10: Bubble shocks (response to the bubble)



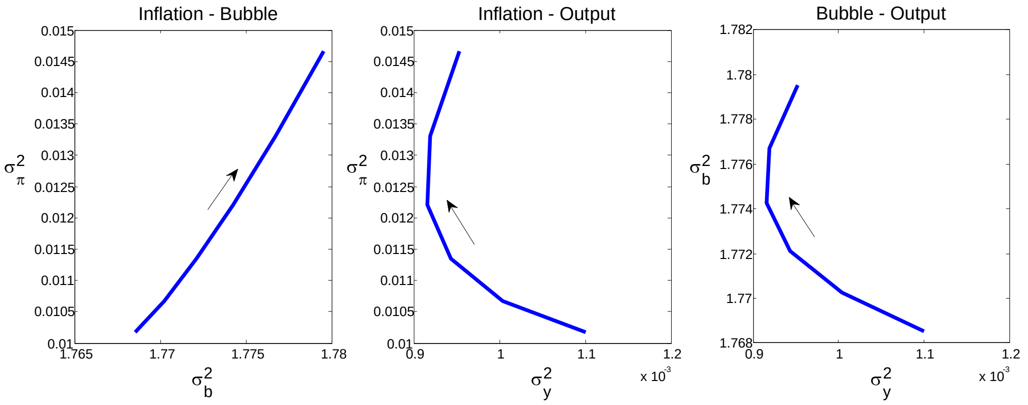
Fixed capital requirements case with leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

Figure IV.2.11: Supply and bubble shocks (response to the bubble)



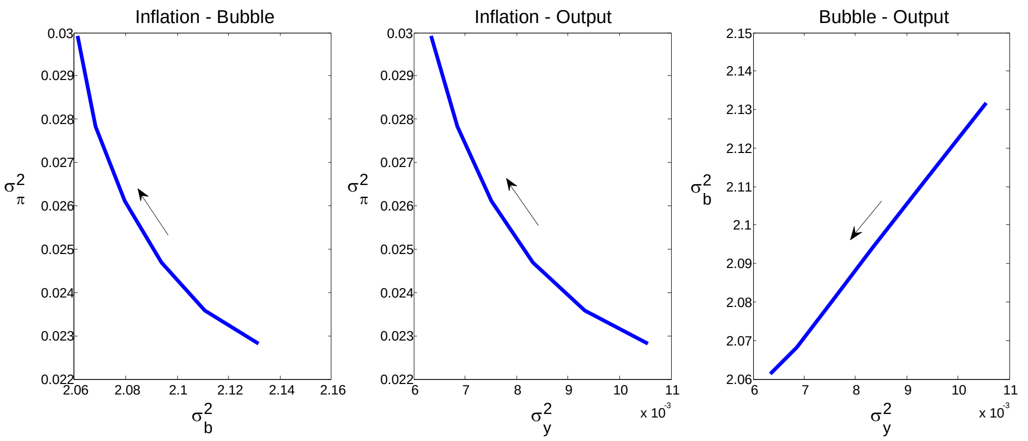
Fixed capital requirements case with leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

Figure IV.2.12: Bubble shocks (response to output gap)



Fixed capital requirements case with leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.2.13: Supply and bubble shocks (response to output gap)



Fixed capital requirements case with leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Still considering a monetary authority implementing a leaning against the wind strategy (*i.e.* $\beta_b \neq 0$) with the prudential instrument in place, let us assume that the increase in the aggressiveness of the central bank's response to shocks manifests through the output gap (increase in β_y). Figures IV.2.12 and IV.2.13 present the consequences of this strategy for financial and macroeconomic stability. Figure IV.2.12 shows that in case of asset price bubble shocks, this strategy generates an increase in both inflation and the bubble volatilities, while the output gap volatility decreases. When bubble and supply shocks occur simultaneously, figure IV.2.13 shows that a trade-off emerges between inflation stabilization and financial stability. The bubble and the output gap volatilities decrease while inflation becomes more unstable. Note that this strategy provides a better outcome than the strategy studied in figures IV.2.10 and IV.2.11 since the levels of variances are significantly lower, especially for the macroeconomic variables.

Conclusions regarding the analysis with fixed capital requirements for banks as a prudential instrument are in line with our discussion so far. First, the direct and more aggressive responses to the bubble do not seem to provide a desirable outcome. When it may be necessary to strengthen the monetary policy responses to financial shocks, central banks should rather increase the extent to which the policy interest rate reacts to the output gap. Second, the simulations results suggest that even if a prudential instrument exists and is devoted to financial stability, the central bank should also be concerned with financial imbalances when setting its policy rate. Indeed, irrespective of the nature of shocks considered in this analysis, the findings show that the combination of the leaning against the wind strategy and the implementation of the prudential instrument provides a better outcome, compared to a framework in which the sole prudential policy prevails. In fact, the former policy approach provides a much better macroeconomic stabilization outcome compared to the latter, while the difference in terms of financial sector stabilization does not appear to be very significant (see figures IV.2.8 / IV.2.9 compared to figures IV.2.12 / IV.2.13).[84]

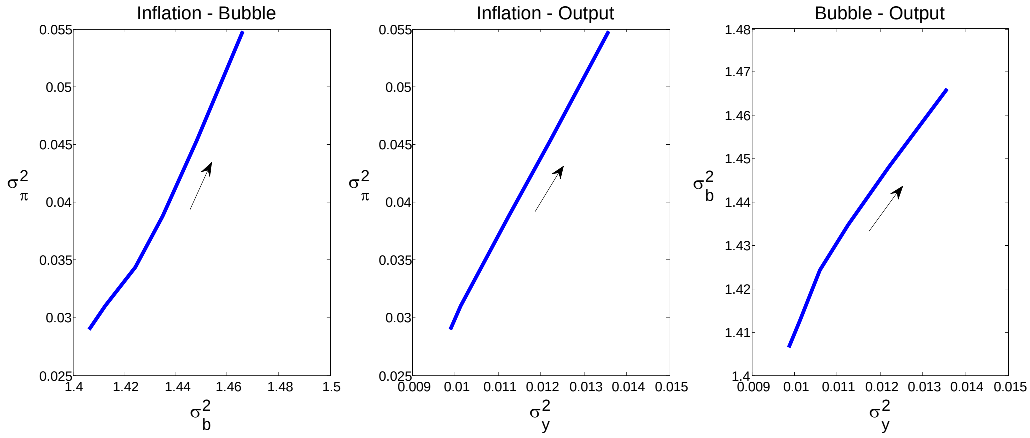
Countercyclical capital requirements

It is now assumed that the bank minimum capital requirement adjusts with the perceived system-wide risk in the economy. As in the previous case, we first investigate the framework in which the authorities rely on this prudential instrument to control financial imbalances and the central bank is not directly concerned with financial stability (β_b = 0). The monetary authority rather responds to the shocks by strengthening the policy interest rate's reaction to output deviations (increase in β_y). In case of asset price bubble shocks, such a strategy generates an increase in all the variables' volatilities (figure IV.2.14). Although these findings may suggest a counterproductive effect of the central bank's reaction, note that the levels of

[84] For the most aggressive central bank response (highest value of β_y) and considering the bubble shocks, the framework that includes the leaning strategy provides inflation and output gap volatilities which are lower by 22% and 88% respectively. Considering the combination of supply and bubble shocks, these volatilities are lower by 15% and 55% respectively. In the two cases, the bubble volatility does not change significantly (about 4% higher).

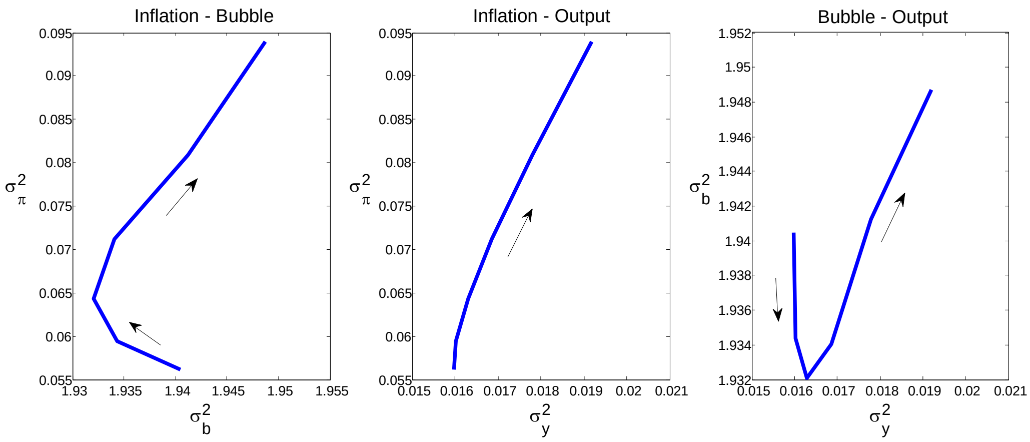
the bubble volatility are much lower compared to all the other strategies that have been investigated so far, highlighting the effectiveness of the countercyclical minimum capital requirements for banks as a prudential instrument. Considering the combination of supply and bubble shocks, figure IV.2.15 shows that more aggressive interest rate’s responses to the output gap generate in a first stage a decrease in the bubble volatility while inflation instability increases (suggesting a trade-off). When the central bank responses become more aggressive, all the variances increase.

Figure IV.2.14: Bubble shocks (response to output gap)



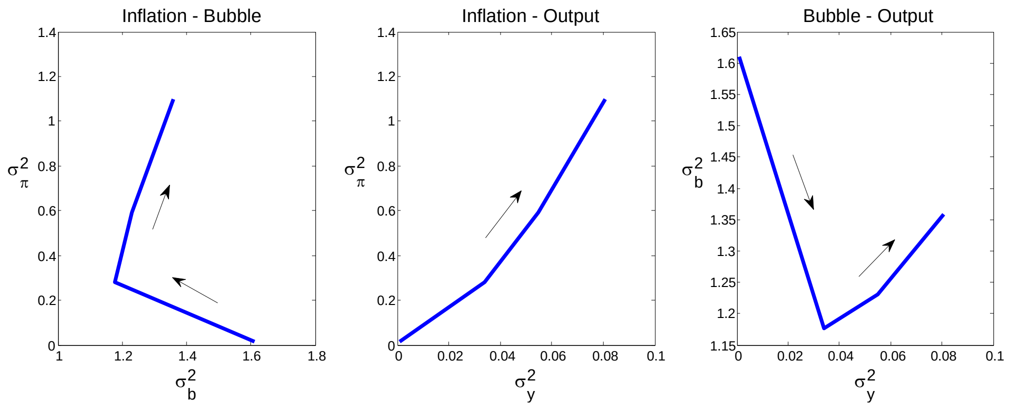
Countercyclical capital requirements case without leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.2.15: Supply and bubble shocks (response to output gap)



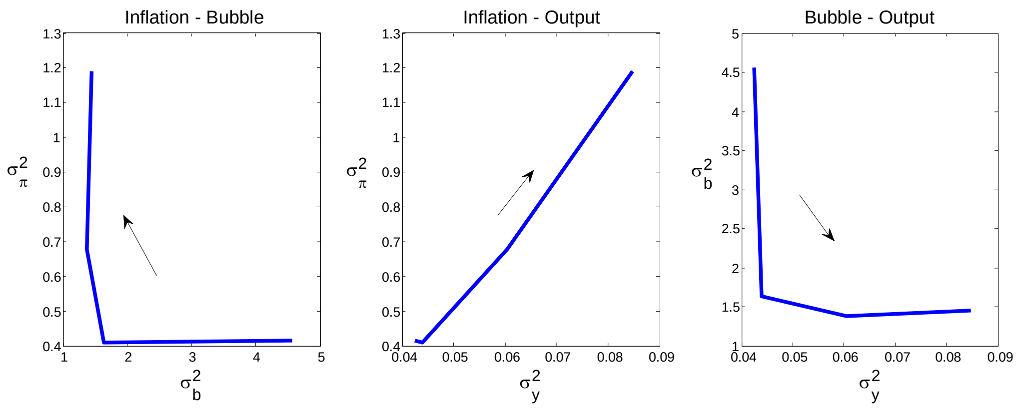
Countercyclical capital requirements case without leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.2.16: Bubble shocks (response to the bubble)



Countercyclical capital requirements case with leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

Figure IV.2.17: Supply and bubble shocks (response to the bubble)



Countercyclical capital requirements case with leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

Assuming that in addition to the implementation of the prudential policy, the central bank responds to financial imbalances by tightening the monetary policy stance ($\beta_b \neq 0$ and increases), figures IV.2.16 and IV.2.17 show that the resulting outcome is not desirable (in line with previous conclusions regarding this particular framework). This strategy generates the highest volatilities for the macroeconomic indicators (inflation and output gap) that the simulations have shown so far. Regarding the bubble volatility when considering asset price bubble shocks, the levels are close to what we found with the previous strategy in which the interest rate responses occur through the output gap (figure IV.2.16). These levels are much higher when asset price bubble and supply shocks occur at the same time (figure IV.2.17). The findings in this case support the conclusions derived from the previous analyses and suggesting that the strategy in which the central bank responds more aggressively to the bubble is too costly and cannot be considered as a policy response to shocks.

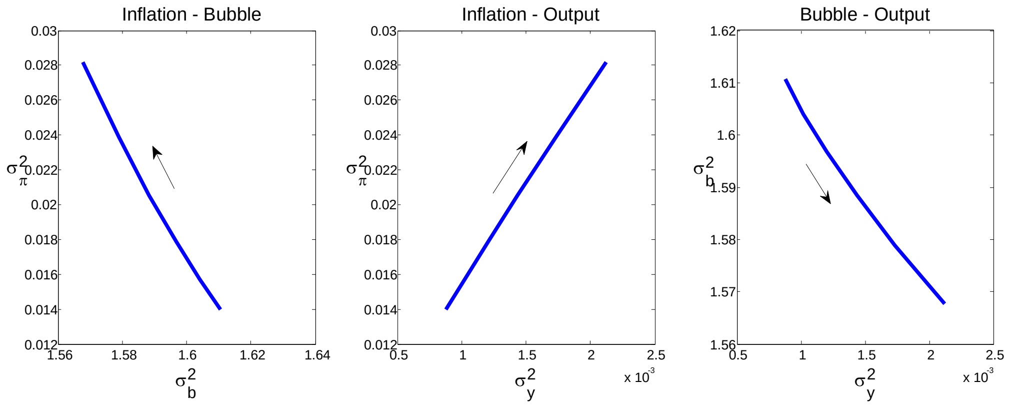
Finally, let us now consider a framework in which while the central bank implements a leaning against the wind strategy ($\beta_b \neq 0$) to complement the prudential policy (the implementation of countercyclical capital requirements), the increase in the aggressiveness of the responses to shocks operates through the output gap (increase in β_y). Figure IV.2.18 shows the effects of this strategy on both macroeconomic and financial stability in case of asset price bubble shocks. The results suggest that the bubble volatility decreases while the output gap and inflation instability increase. A trade-off therefore emerges between macroeconomic and financial stability. Note however that this strategy provides a better outcome in terms of macroeconomic stabilization, compared to the strategy in which the prudential policy is implemented without the leaning against the wind. When the central bank's response is the most aggressive (when β_y reaches its highest value) inflation and output gap volatilities are lower by about 50% and 85%, respectively. Regarding the bubble volatility, the levels appear to be higher with this latter strategy by about 7%. If we consider that the gains in terms macroeconomic stabilization exceed the losses in terms of financial stability, this strategy may be preferred to the framework that excludes the leaning against the wind and relies solely on the prudential instrument to deal with the financial instability issue (see figure IV.2.14 compared to figure IV.2.18). [85]

Figure IV.2.19 shows the effects of the same strategy considered above when bubble and supply shocks occur at the same time. The simulations' results show that the bubble volatility decreases but at the cost higher inflation instability. The output gap volatility also decreases in a first stage, but increases subsequently when the central bank responses become more aggressive. The trade-off between macroeconomic and financial stability remains relevant in this case. Compared with the framework in which the prudential instrument prevails without central bank's response to financial imbalances, this strategy provides a better outcome in terms of macroeconomic stabilization (in line with the findings discussed in the previous

[85] This type of comparison is purely quantitative and may bear some limitations in the sense that a 1% increase in the bubble volatility does certainly not worth a 1% increase in inflation or output gap volatility, in terms of welfare.

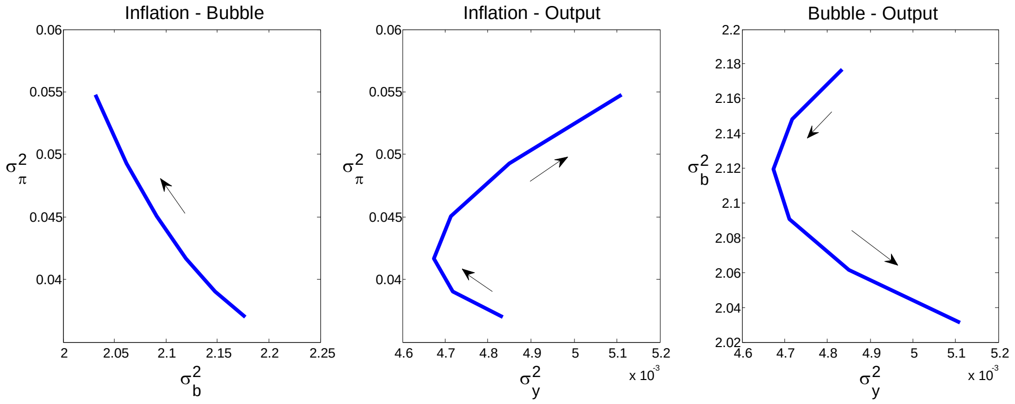
paragraph). Inflation and output gap volatilities are much lower, while the difference in terms of bubble volatility is less significant (differences are approximately of the same magnitude as in the previous case). This also supports the relevance for central banks to lean against the wind, even when the prudential instrument exists (see figure IV.2.15 compared to figure IV.2.19).

Figure IV.2.18: Bubble shocks (response to output gap)



Countercyclical capital requirements case with leaning. Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

Figure IV.2.19: Supply and bubble shocks (response to output)



Countercyclical capital requirements case with leaning. Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to output gap varies between 0.5 and 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

On the whole, our analysis of the effectiveness of alternative strategies when the countercyclical capital requirement prevails as the prudential instrument reveals broadly the same conclusions as in previous investigations. A direct and stronger response of the central bank to the bubble is not the best strategy. If a tighter monetary policy seems to be required in response to shocks, the short term interest rate should react more aggressively to output deviations (since the bubble affects the output gap) rather than to financial imbalances. Although constraining the credit supply through a countercyclical minimum capital requirement for banks seems to be effective in improving the financial sector stability, our analysis also points the relevance for the central bank to lean against the wind. A framework that combines these two pillars provides a much better macroeconomic stabilization outcome (even if the performances in terms of financial stability are slightly impaired compared to the strategy that does not include the leaning against the wind policy).

III.3. Summary and further discussion

The previous section discusses the main simulations’ results considering successively the unconstrained case, the fixed capital requirements case, and the countercyclical capital requirements case. Thus far, the findings from these different scenarios have been discussed separately, without any comparison between their respective performances in achieving both macroeconomic and financial stability. This section first summarizes our main conclusions regarding the alternative strategies investigated in section III.2. Next, it proceeds with a comparative analysis in order to assess whether one these alternative strategies performs better than the others, given the type of shocks.

The simulations conducted for the purpose of our analysis allow deriving some interesting conclusions regarding the effectiveness of alternative response strategies to financial shocks. First, the findings suggest that a strategy where the central bank tightens its policy rate directly and more aggressively in responses to asset price inflation is undesirable. Indeed, an increase in the short term interest rate responses to the bubble generates the highest levels of the macroeconomic volatility observed in each case study considered in our investigation. Moreover, such an approach does not seem to significantly improve the financial sector stability. We find that a better strategy for the monetary authority’s reaction to financial shocks is to increase the policy rate responses to the output gap, since the bubble affects the aggregate demand. This 'indirect' response provides a better outcome in terms of macroeconomic and financial stability.

Second, the simulations suggest that although the prudential instrument (constraints on bank capital to reduce the credit supply and contain the bubble) effectively improves the financial sector stability (reduces the bubble volatility, compared to the framework without prudential policy), central bank should implement a leaning against the wind strategy by responding to financial imbalances in its reaction function. This two-pillar framework which includes a macroprudential policy instrument and a leaning against the wind strategy delivers much better economic stability conditions. Note however that, as stressed above, an increase in the strength of the leaning strategy in response to financial shocks is not desirable.

These conclusions seem to be particularly relevant since they hold whatever there is a prudential instrument or not (particularly for the first point), whatever the type of prudential instrument (fixed or countercyclical minimum capital requirements for banks) and whatever the type of shocks considered (asset price bubble shocks, or bubble and supply shocks). We now assess comparatively the alternative strategies which have been found to perform better in each of the three main scenarios considered (unconstrained, fixed and countercyclical capital requirements).

Unconstrained versus fixed capital requirements

For the unconstrained case, we find that the best strategy is the one which implies a leaning against the wind strategy, while central bank responds more aggressively to the output gap. Complementing this strategy with a fixed minimum capital requirement for banks (as a prudential instrument) yields a framework which significantly improves the macroeconomic stabilization performances. Precisely, when the central bank's response is the most aggressive (β_y reaches its highest value) in case of asset price bubble shocks, inflation and output gap volatilities are both approximately 30% and 37% lower, respectively, while the bubble volatility is about 8% higher. Assuming that the gains in terms macroeconomic stabilization offset the losses in terms of financial stability, the framework that includes the fixed capital requirement seems to perform better in case of bubble shocks.

When asset price bubble and supply shocks occur simultaneously, the conclusion is more mixed. The introduction of the prudential instrument lowers inflation and output gap volatilities by about 16% and 12% respectively, and the bubble volatility is approximately 13% higher (compared to the baseline framework in which the central bank lean against the wind and responds more aggressively to the output gap). Choosing between the two frameworks in this case is trickier and may depend on the current stance of the financial and macroeconomic environments, and the extent to which further instability may be more or less costly.[86]

This first comparative analysis suggests that in case of financial shocks, the framework which relies on a fixed minimum capital requirement for banks in addition to the leaning against the wind strategy implemented by the central bank provides a better macroeconomic and financial stabilization outcome (compared to the framework in which the latter strategy prevails without prudential instrument). When asset price bubble and supply shocks occur at the same time, the comparison is rather inconclusive.

Fixed versus countercyclical capital requirements

The simulations regarding the implementation of the countercyclical capital requirement show that this formulation of the prudential instrument is more effective (than the fixed capital requirement) in stabilizing the financial sector; a finding in line with the BCBS's recommendations. We further show that complemented with a leaning against the wind strategy, in which central bank responds more aggressively the output gap, the resulting framework generates a better macroeconomic stabilization outcome. Compared with the fixed capital requirements framework (which also includes the leaning against the wind strategy) in case of bubble shocks, the bubble volatility is about 12% lower. However, inflation and output gap volatilities increase significantly (roughly double). This makes the two frameworks more competing and highlights the trade-off between macroeconomic and financial stability.

When considering the case where asset price bubble shocks occur together with supply shocks, conclusions are also mixed. The countercyclical capital requirement with leaning

[86] If the financial stance is already highly unstable, and further instability could generate important financial and macroeconomic costs, the best strategy might be the one that minimizes the bubble volatility.

strategy shows that the bubble and the output gap volatilities are 1.5% and 20% lower, respectively, while the inflation volatility is 83% higher (compared to the framework that includes fixed capital requirements with leaning).

Overall, the above results suggest that, focusing on financial stability, the countercyclical capital requirement performs better than the fixed capital requirement. The prudential instrument which is automatically fine-tuned to the perceived level of risk thus provides better financial stability conditions than the one which remains fixed. Our simulations show that the lowest levels of financial instability are found in the case study where the countercyclical capital requirement is implemented. However, the simulations also evidence that this framework does not provide the best macroeconomic stability conditions, suggesting that the implementation of the prudential policy may generate higher macroeconomic instability. When considering the case where there are both asset price bubble and supply shocks, our analysis seems to be rather inconclusive. The preferred strategy may depend on the prevailing financial and macroeconomic conditions, and the economic consequences of further increase in financial or macroeconomic instability.

IV. Conclusion

The main purpose of this chapter is twofold: first, it investigates the extent to which a monetary policy framework in which the central bank relies on the short term interest rate as a policy instrument to achieve financial stability in addition to its standard macroeconomic stability goal, may generate trade-offs between objectives. Second, it investigates the effectiveness of alternative policy frameworks which include a macroprudential instrument explicitly devoted to deal with financial imbalances (and potentially complemented with monetary policy interventions), in improving the stability of the financial sector and the overall economic environment. The chapter proceeds in two main steps.

The first analysis is based on the reduced form new Keynesian model which describes the economy through a hybrid IS curve equation capturing the aggregate demand, a hybrid Phillips curve equation capturing the aggregate supply, and the central bank's reaction function. This standard three-equation model is complemented with an asset price bubble equation which intends to capture the financial risk. The bubble process described in this framework differs from the large part of the existing literature which assumes that financial bubbles are exogenous. We rather follow the current debate, revived in the aftermath of the late 2000s financial crisis, and arguing that the monetary policy stance affects the stakeholders' risk taking behavior. We endogenize our bubble process by assuming that it can be affected by the policy short term interest rate. The model further makes the realistic assumption that asset price deviations from the fundamental value affect the aggregate demand through various channels.

The recent financial crisis has also revived the debate on the role of monetary policy in preventing financial crisis or containing financial risks. The issue is whether or not central banks should respond directly to financial imbalances in their monetary policy-making (the lean versus clean debate). While the cleaning approach seems to have prevailed in the pre-2007 period, the scope and persistent effects of the crisis have highlighted the relevance for monetary policy to lean against the wind in order to avoid financial bubbles or mitigate the economic consequences which emerge when they burst. We mimic this leaning strategy by assuming that the central bank's policy rate responds to financial imbalances in addition to inflation and output gaps, and we investigates the effectiveness of such a strategy in terms financial and macroeconomic stability. The assessment relies on a comparative-static-type analysis in which we simulate various central banks' responses to shocks, and we observe the effects of these responses on the volatility of variables of interest (inflation, output gap and asset price bubble).

The main results suggest that central banks implementing a policy strategy in which the short interest rate responds to financial imbalances may face trade-offs between its standard macroeconomic stability objective and financial stability. The simulations reveal that when the central bank responds to financial imbalances, in the best-case scenario, this strategy succeeds in improving the financial sector stability but at cost of higher inflation volatility. A worst-case scenario emerges in some cases, and suggests that the leaning against the wind strategy can generate a counterproductive outcome in the sense that central bank responses deteriorate both macroeconomic and financial stability. These results stress the challenges that the monetary authorities may face in conducting their policy. The findings suggest that the leaning against the wind strategy does not allow achieving financial stability without hampering the macroeconomic environment. To some extent, this conclusion is in line with the current debate which emphasizes the need to build a policy framework in which new instruments should be explicitly set to tackle the financial instability issue, while the short term interest rate remains focused on the traditional macroeconomic stability objective. In the second part of the chapter, we assess the extent to which such a framework may improve the policy outcome.

The second analysis extends the model described above by including a macroprudential instrument which aims at controlling the financial risk. To this end, we model a banking sector captured by a set equations including credit supply and demand equations, the bank deposit equation and the bank capital accumulation equation. It is assumed that the banking sector can contribute to generate higher financial instability by feeding the asset price bubble. This assumption is based the existing literature stressing the positive correlation between credit aggregates and financial bubbles, and on the recent experience of the housing price bubble in the U.S. that has been accompanying with a large increase in loan supply. Regarding the prudential instrument, we follow the BCBS's recommendations and assume that the prudential authority can set up a regulatory framework to control the bank loan supply. Precisely, two alternative regulatory constraints are considered: fixed minimum capital requirements for bank, and countercyclical capital requirements. The latter formulation of the prudential instrument has been particularly advocated recently, following the financial crisis. This formulation allows an adjustment of the required capital buffer with perceived changes in the system-wide risk. The constraint imposed on bank capital intends to reduce the loan supply and ultimately deflate the financial bubble (or avoid asset price bubble inflation), preserving the financial sector stability. We further assume that the implementation of the prudential policy can be complemented with monetary policy responses to financial shocks.

The comparative analysis of various strategies considered with this new theoretical framework relies on an approach which is similar to the procedure used in the first analysis. We are however also interested in comparing the performances of these alternative strategies in providing better stability conditions (implying lower volatility for the variables of interest). Faced with financial shocks, the main results can be summarized as follows. First, the simulations' result shows that the implementation of the prudential instrument (fixed or countercyclical minimum capital requirements for banks) significantly improves the financial sector stability, compared to a framework without prudential policy. This result supports the relevance of a strategy which includes a separate instrument (or policy) designed to deal with financial imbalances. Second, our findings reveal that, compared to the fixed minimum capital requirements, the countercyclical constraint on bank capital provides better financial stabilization performances; a conclusion in line with recent Basel III recommendations.

Third and interestingly, we show that a two-pillar framework in which in addition to the implementation of the prudential policy, the central bank leans against the wind, provides better outcomes in terms of financial and macroeconomic stability. However, faced with financial shocks, strengthen the short term interest rate responses to financial imbalances is undesirable since it produces higher financial and macroeconomic instability. When a more aggressive central bank's response is required, the policy rate setting should rather be guided by the output gap (as long as the bubble affects the aggregate demand). Faced with supply and financial shocks which occur simultaneously, our comparative analysis between alternative strategies seems to be inconclusive. The best strategy may depend on the current financial and macroeconomic stability conditions, and the extent to which further instability in one of both sectors may generate higher welfare losses.

One of the main conclusions of our analysis in this chapter is that, by responding more aggressively to the output gap, rather than to financial imbalances, the monetary authorities may avoid the trade-off between macroeconomic and financial stability (in case of financial shocks affecting the aggregate demand). This finding can be related to the notion of the "divine coincidence" characterizing the standard new Keynesian model, as suggested by Blanchard and Gali (2007). They stress that one feature of the new Keynesian model (mostly reflected through the new Keynesian Phillips curve) is that, stabilizing inflation also stabilizes the output gap, such that the central bank does not face a trade-off between these two objectives (this is due to the absence of non-trivial real imperfections in the model). Our findings suggest that such "divine coincidence" can also emerge regarding the financial and macroeconomic stability objectives in the monetary policy-making, if the central bank strengthens its output stabilization achievements.

Moreover, the relevance to strengthen the response to the output gap (rather than to the bubble) can be related to the policy aiming to reduce the credit to GDP ratio. This latter ratio is usually considered as a leading indicator of financial risk in the economy. Therefore, being able to control bank credit is crucial to maintain or ensure the stability of the financial sector. In our model, the bank loan supply depends positively on the output gap. As a consequence, a better stabilization of the output gap can be expected reduce the risk of excessive loan provision, and ultimately reduce the financial risk. This effect, coupled with the bank capital regulation aiming to build buffer but also to constrain the bank loan, leads, as we show, to a better overall stabilization outcome when financial shocks occur.

Although interesting, the conclusions derived from the analytical framework of this chapter are not free from some limitations. Let us stress two main points. First, our comparative assessment of alternative strategies in section III is (partly) based on a purely statistical and quantitative approach regarding the changes in macroeconomic and financial volatility from one strategy to another. This type of comparison may be questionable in the sense that the losses associated to the same percentage increase in the bubble volatility or inflation/output gap volatility may be different. In this respect, a welfare analysis when comparing these alternatives strategies might be more relevant. Consequently, a potential extension of the model would be a welfare analysis based on the central bank's (and the prudential authority) loss function(s). Second, our results suggest that while the introduction of the prudential instrument significantly improves the financial sector stability, it may generate higher macroeconomic instability. This finding raises the issue of the necessary coordination between monetary and macroprudential policies; an issue which is not investigated here and can be considered in an extended model. As discussed in the first chapter, the coordination between the two policies may be of relevance in determining their achievements.

One of the main advantages of our theoretical framework is that it relies on a very simple, intuitive and straightforward model which allows assessing several important issues of the current debate on the monetary policy-making. However, such a simple framework bears some limitations regarding for example the ability to go one step further and assess other issues related to the policy optimality, welfare analyses or coordination between the two policy instruments. Note also that the prudential instrument considered in our analysis is one among a large set of tools available to the regulatory authorities. Although it is among the most relevant instruments, especially for developed countries, others policy interventions seem to be subject to particular attention, depending on sources of risk. An example is the frequent foreign exchange interventions in emerging countries to deal with risks related to surges in international capitals and their higher vulnerability to external shocks which may destabilize the domestic financial system. The next chapter investigates this particular issue.

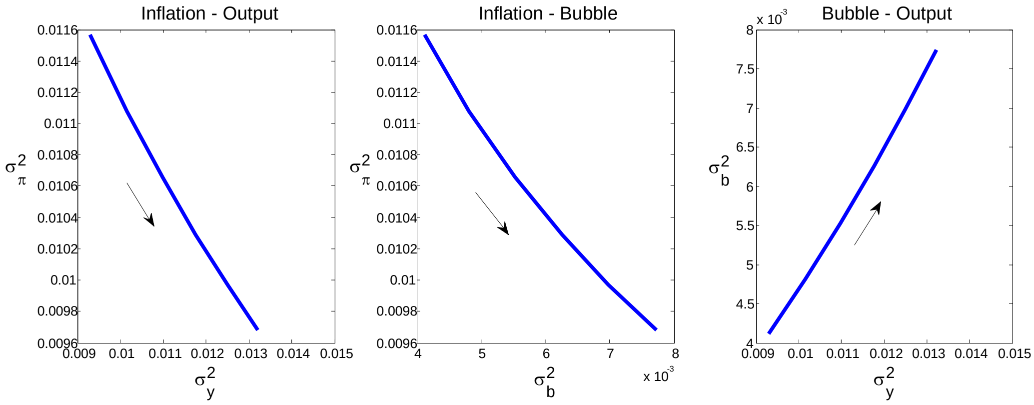
Appendices

Appendix table IV.1: Baseline calibration of the model

Phillips curve	
α	0.52
λ	0.18
IS equation	
δ	0.56
σ	-0.06
φ	0.02
υ	-0.029
Central bank's reaction function	
β_i	0.98
β_π	1.5
β_y	0.5
β_b	0.15
Bubble equation	
γ	0.06
ϕ	0.1
$\overline{q}$	0.8
$\overline{i}$	0.04
Baking sector block	
c_y	1.5
c_i	0.1
d_y	1.5
d_i	0.08
n_y	1.5
N/C	0.105
Capital constraint equation	
e	0.105
μ_1	1000
μ_2	110

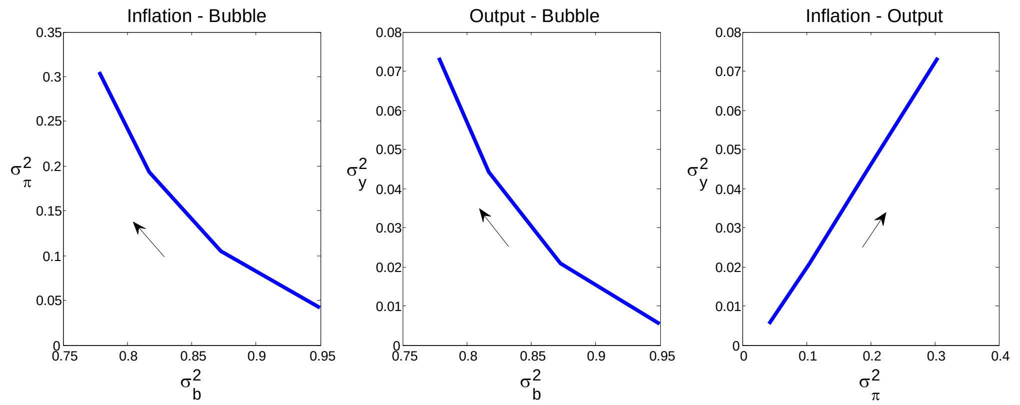
Appendix figure IV.1: Robustness - Bubble affected by levels of the interest rate

1.a: Supply shocks (response to inflation)



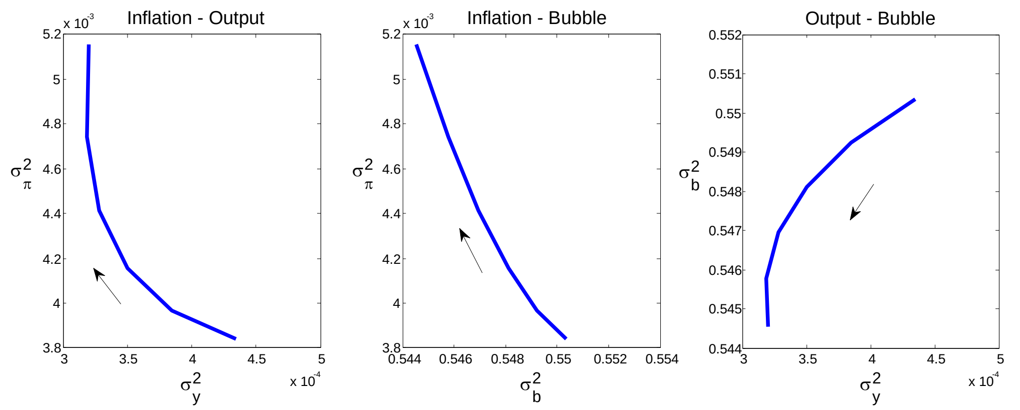
Variances of inflation, output gap and the bubble following supply shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

1.b: Bubble shocks (response to the bubble)



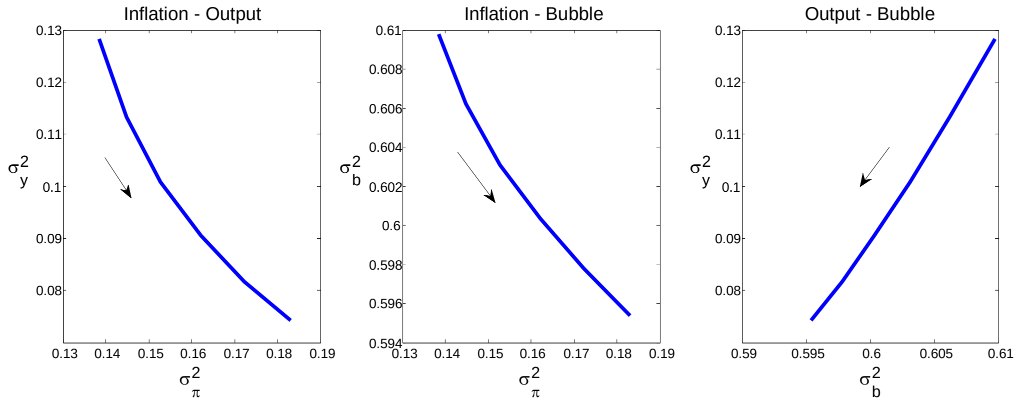
Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

1.c: Bubble shocks (response to output gap)



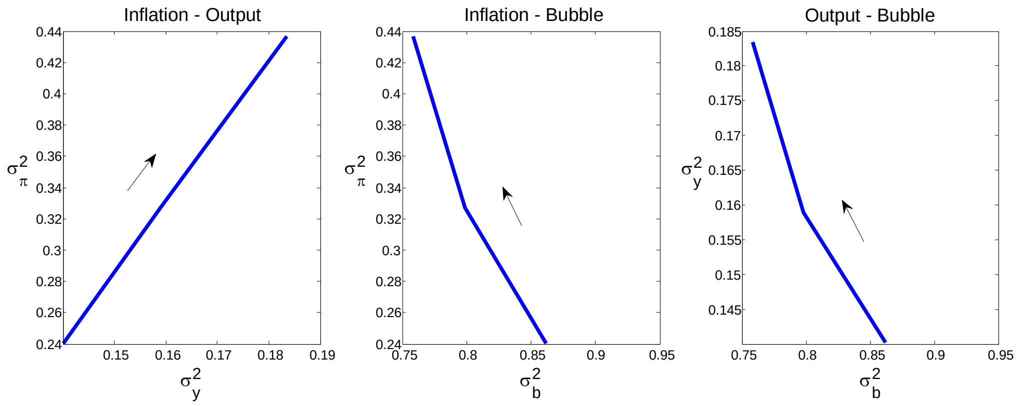
Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

1.d: Supply and bubble shocks (response to output gap)



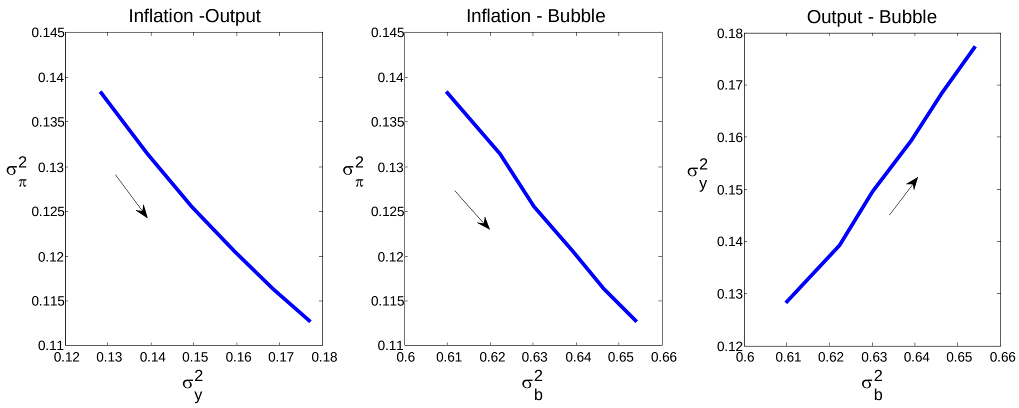
Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

1.e: Supply and bubble shocks (response to the bubble)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

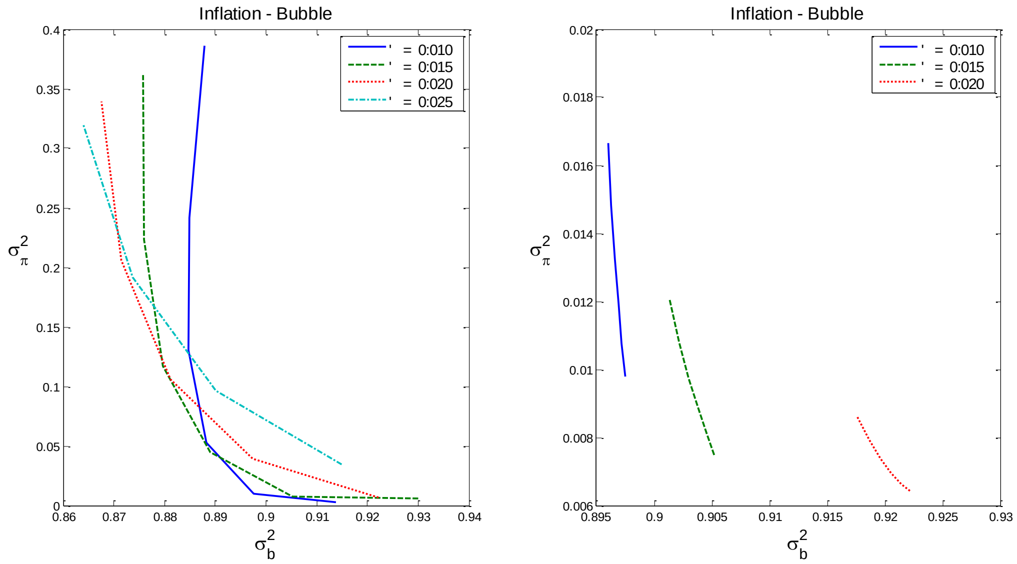
1.f: Supply and bubble shocks (response to inflation)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

<u>Appendix figure IV.2</u>: Robustness to alternative values of φ

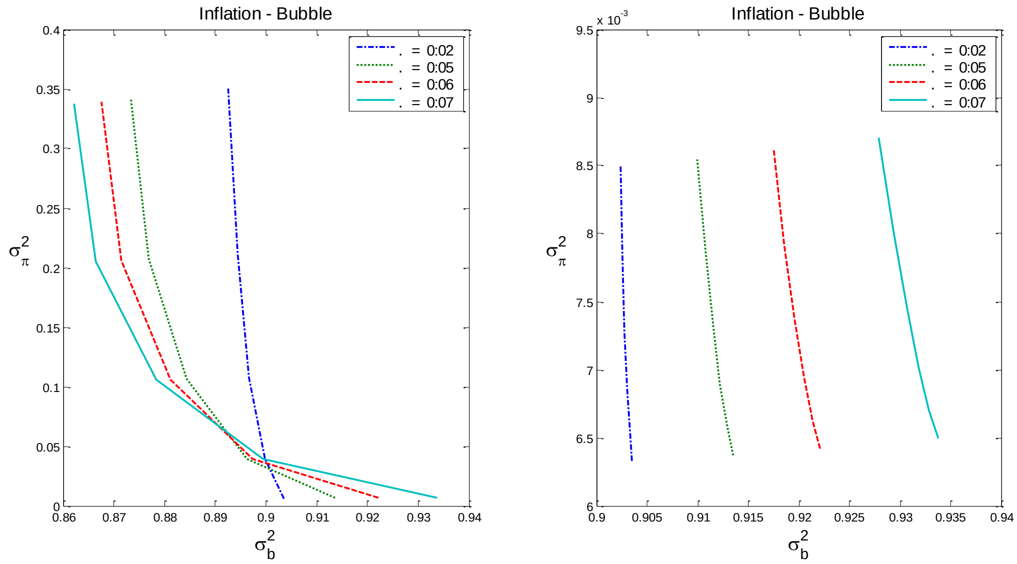
Bubble shocks (response to the bubble [left chart] and to output gap [right chart])



Left panel - Response to the bubble: Variances of inflation and the bubble following bubble shocks. The response to the bubble varies from 0.15 to 0.75 and all other parameters remain the same. Right panel - Response to the output gap: Variances of inflation and the bubble following bubble shocks. The response to the output gap varies from 0.5 to 1.5 and all other parameters remain the same. We do not present in this panel the result for φ =0.025, as the volatilities are much reduced and these smaller values make the figure difficult to read. Note however that the trade-off is still present.

<u>Appendix figure IV.3</u>: Robustness to alternative values of γ

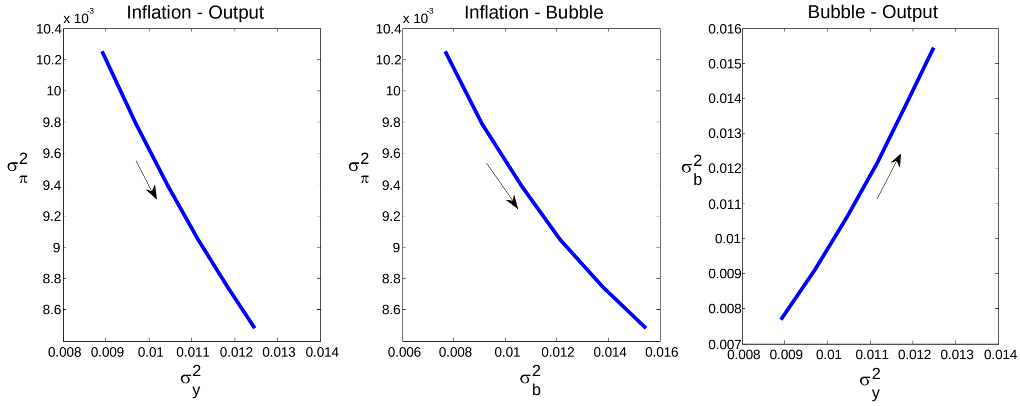
Bubble shocks (response to the bubble [left chart] and to output gap [right chart])



Left panel - Response to the bubble: Variances of inflation and the bubble following bubble shocks. The response to the bubble varies from 0.15 to 0.75 and all other parameters remain the same. Right panel - Response to the output gap: Variances of inflation and the bubble following bubble shocks. The response to the output gap varies from 0.5 to 1.5 and all other parameters remain the same.

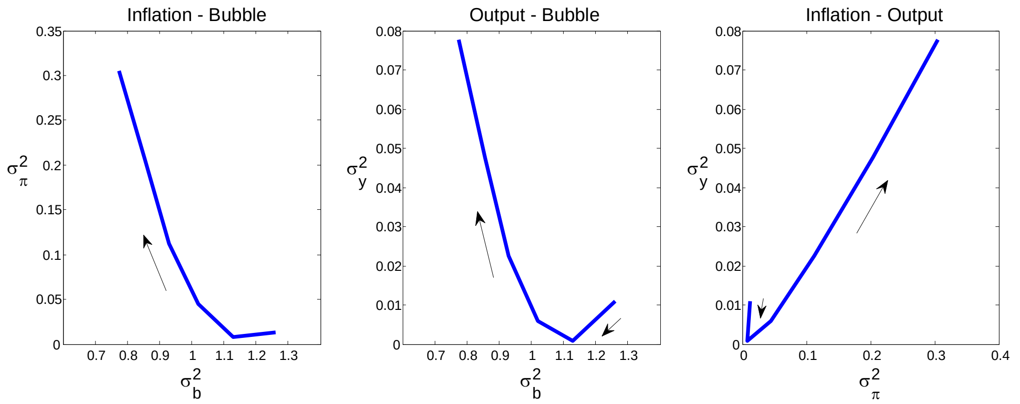
Appendix figure IV.4: Robustness to alternative selection of shocks

4.a: Supply shocks (response to inflation)



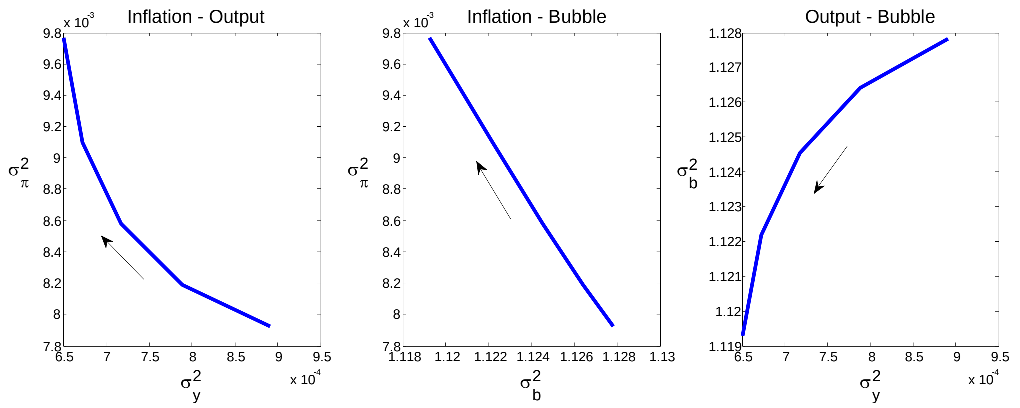
Variances of inflation, output gap and the bubble following supply shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

4.b: Bubble shocks (response to the bubble)



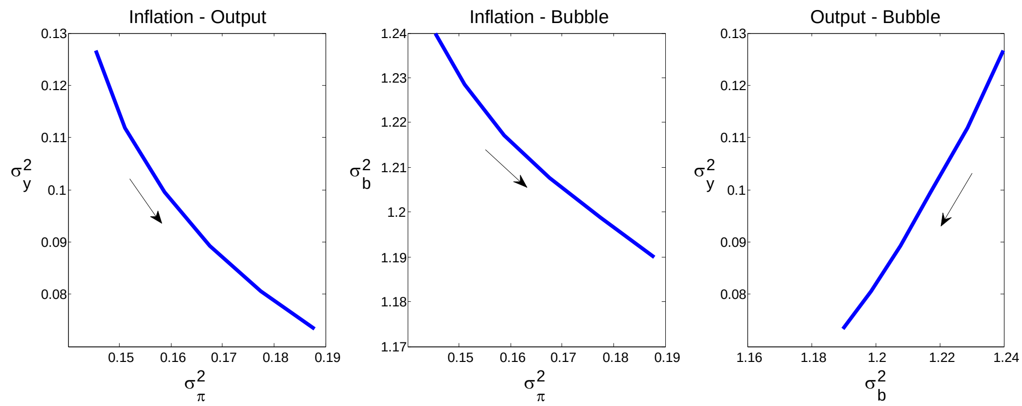
Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

4.c: Bubble shocks (response to output gap)



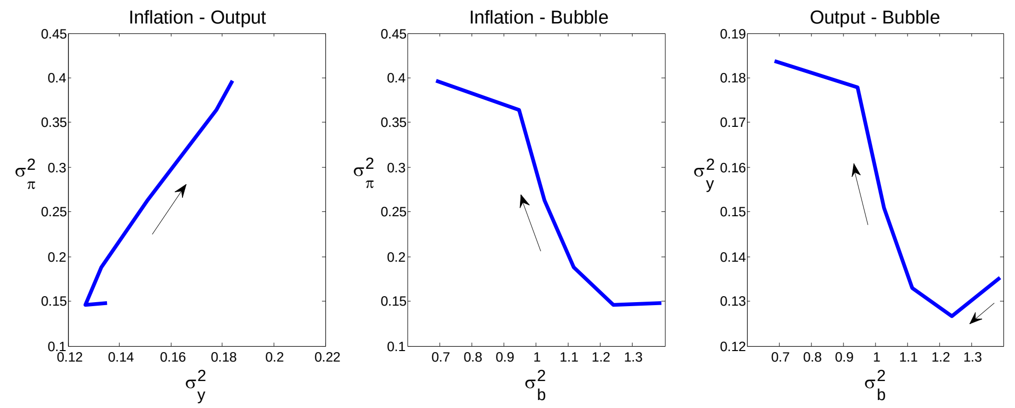
Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

4.d: Supply and bubble shocks (response to output gap)



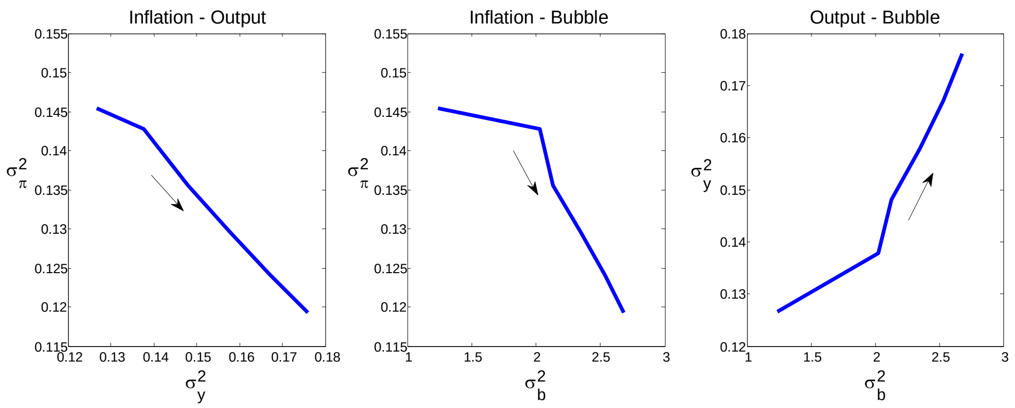
Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

4.e: Supply and Bubble shocks (response to the bubble)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

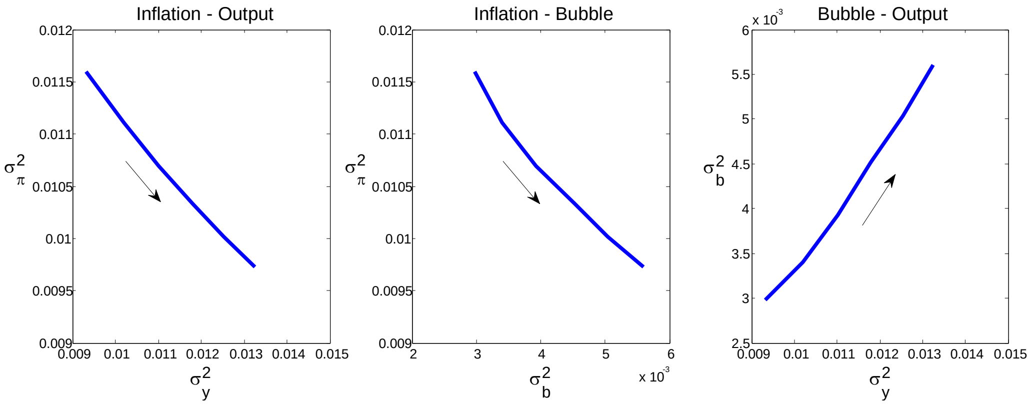
4.f: Supply and Bubble shocks (response to inflation)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

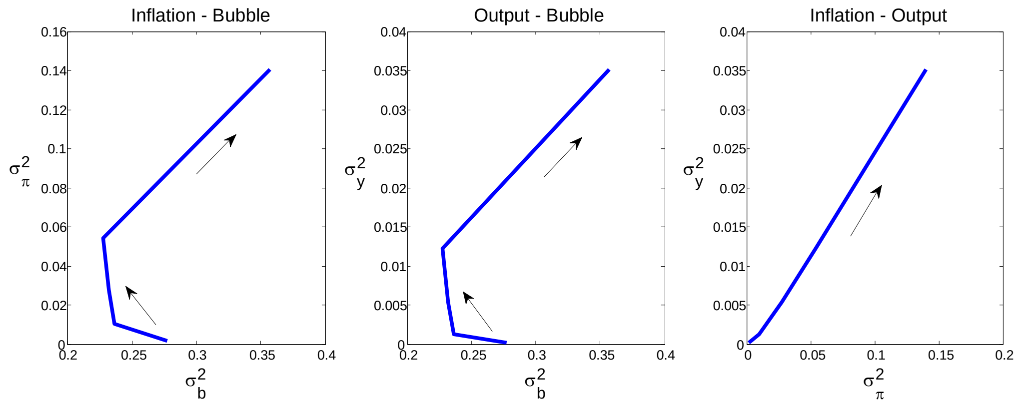
<u>Appendix figure IV.5</u>: Robustness to alternative selection of q_t

5.a: Supply shocks (response to inflation)



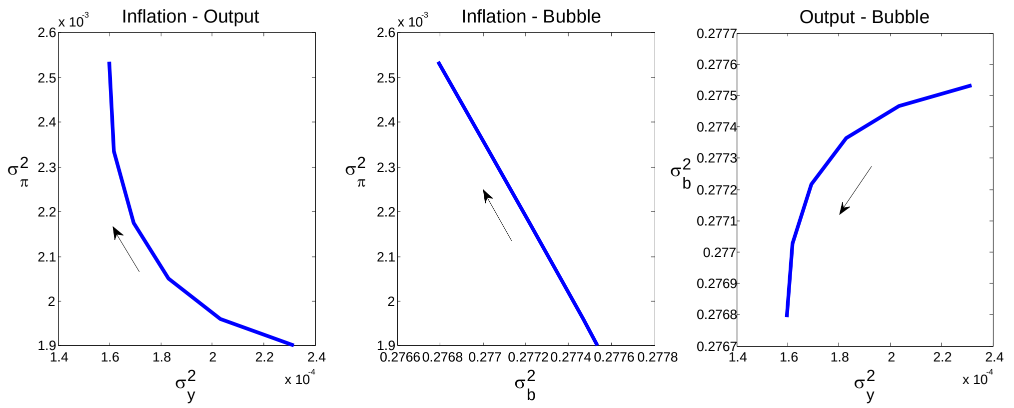
Variances of inflation, output gap and the bubble following supply shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

5.b: Bubble shocks (response to the bubble)



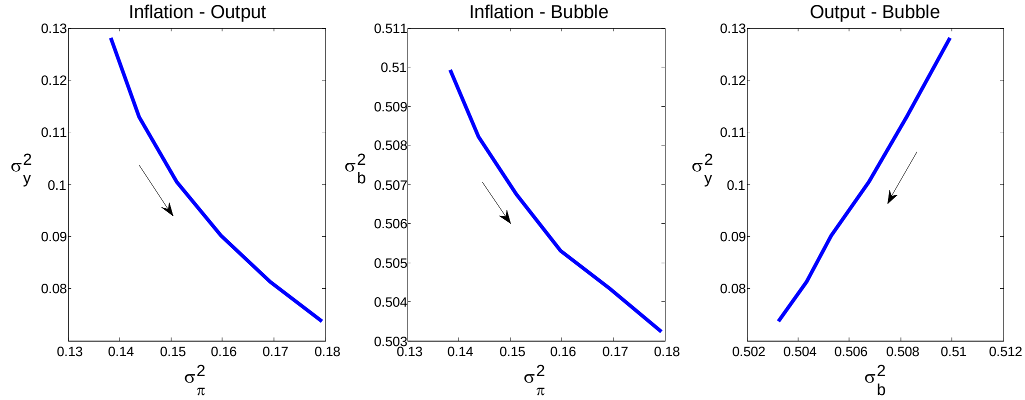
Variances of inflation, output gap and the bubble following bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

5.c: Bubble shocks (response to output gap)



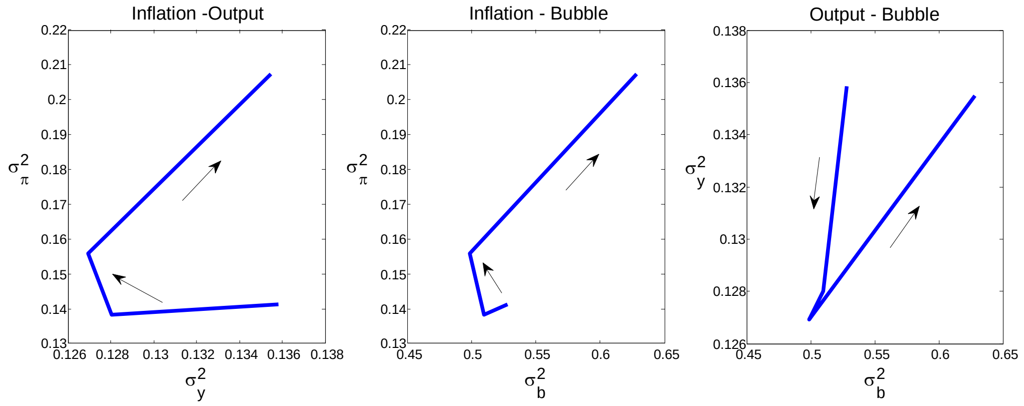
Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

5.d: Supply and bubble shocks (response to output gap)



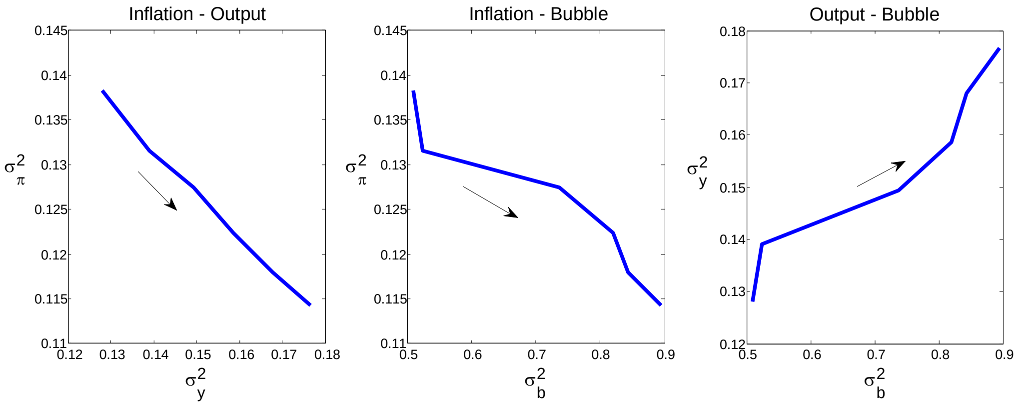
Variances of inflation, output gap and the bubble following bubble shocks. The response to output gap varies from 0.5 to 1.5 and all other parameters remain the same. The arrows indicate an increase in β_y.

5.e: Supply and Bubble shocks (response to the bubble)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to the bubble varies from 0 to 0.75 and all other parameters remain the same. The arrows indicate an increase in β_b.

5.f: Supply and Bubble shocks (response to inflation)



Variances of inflation, output gap and the bubble following supply and bubble shocks. The response to inflation varies from 1.5 to 2.5 and all other parameters remain the same. The arrows indicate an increase in β_π.

Chapter V

Financial and Macroeconomic Conditions, Foreign Exchange Interventions, and Inflation Targeting*

"*Inflation targeting central banks have argued that they care about the exchange rate to the extent that it affects inflation, but it is worth asking whether this should be the only effect of exchange rate they ought to consider*." (Blanchard et al., 2013)

I. Introduction

The previous chapter deals with the issue of the effectiveness of various policy responses from monetary and prudential authorities to financial shocks. It assesses the extent to which one of the most common and prevailing macroprudential instrument, namely, bank capital constraints,

* A version of this chapter is a forthcoming publication in the IMF Working papers series – International Monetary Fund.

improves the stability of the financial system and the macroeconomic environment. As mentioned in conclusion of the chapter, this instrument is however one of the large set of tools on which regulatory authorities rely for the purpose of ensuring financial stability. Indeed, depending on the type of shocks a country has to face with, and consequently, depending on the main source of risk for the financial sector, diverse alternative policy interventions and instruments can be implemented. In this regard, the concern for external risks and the related (important) exchange rate fluctuations in emerging countries deserves a particular attention. Therefore, this chapter provides a discussion on foreign exchange interventions, as another prudential policy response to financial risks. It intends to show that interventions on the foreign exchange market are used as a strategy to address external financial risks.

The emerging markets financial vulnerability to external shocks has been largely documented in the existing literature. The recent surge in international capital flows to emerging countries, following the global financial crisis, has revived concerns for risks associated to flows of international capitals in these economies. This issue is further emphasized in the current debate on the potential consequences on emerging markets financial stability of the U.S. Federal Reserve monetary normalization, after the unconventional monetary policy period. In response to this fragility with regards to international shocks, many emerging countries have setup prudential frameworks including instruments related to capital controls or currency mismatch. An important and common tool also used to attempt to mitigate their external vulnerability is the control of the exchange rate. Indeed, exchange rate fluctuations may be perceived as consequences of various types of shocks and as an important source of risk, as we discuss in further details bellow. Controlling the changes in exchange rate therefore appears as a tool to preserve the stability of the domestic financial system, but also the macroeconomic environment.

To emphasize the relevance of the control of exchange rate among emerging markets, this chapter provides some evidence that even those countries which commit to a freely floating exchange rate regime, significantly deviate from this commitment to cope with financial risks. While a commitment to total flexibility of the exchange rate implies no or very limited attempts to control exchange rate fluctuations, we show that when the financial conditions deteriorate (suggesting higher financial fragility), foreign exchange interventions are used as a tool to mitigate the exposure to external financial risks. Since the macroeconomic conditions are also likely to play an important role in determining the extent to which a country may be worried about the changes in exchange rate, we investigate this issue as well. In short, we intend to show that countries with poor financial and macroeconomic conditions, countries which are more vulnerable to external shocks, are more likely to rely on foreign exchange interventions as a prudential tool or as means to improve their policy outcome.

To this end, we start by identifying those emerging countries which (at least officially or in theory) are supposed to operate in a freely floating exchange rate regime. In this respect, countries which have adopted the inflation targeting monetary policy strategy offer an interesting baseline for our study, for two main reasons. First, as shown in the preliminary statistical analysis in the next section (figure V.1), the exchange rate regime is on average more flexible in these countries, compared to other emerging markets. Second and more importantly, by adopting the inflation targeting strategy, these countries officially commit to a freely floating exchange rate regime (for a credible and effective inflation targeting framework). However, we aims at demonstrating that some of those targeters deviate from this commitment by intervening on the foreign exchange market and by attempting to control the exchange rate as means to safeguard their financial system from potential external risks, and to improve their macroeconomic stability performances.

The empirical investigation relies on a large sample of emerging countries over a period covering more than two decades, and proceeds as follows. First, we assess the effect of inflation targeting on the de facto exchange rate regime and evidence that inflation targeting is positively correlated with exchange rate flexibility. Second, we assess the extent to which this effect can be modified by the countries' financial and macroeconomic conditions. Especially, as discussed above, it is hypothesized that poorer financial conditions and higher financial sector vulnerability to external risks will increase foreign exchange interventions, and consequently reduce the positive effect of inflation targeting on exchange rate flexibility. In the same line of argument, poorer performances in stabilizing the domestic economy will increase the likelihood for foreign exchange interventions (as means of policy adjustment), therefore, reducing the flexibility of the exchange rate regime. We interpret the role of foreign exchange interventions in this framework as an instrument aiming to improve financial stability. For inflation targeters whose inflation stabilization performances do not seem to be satisfactory, foreign exchange interventions are used to improve their policy achievements.

For the purpose of investigating the role of the financial conditions on exchange rate flexibility, we rely on a set of four variables assumed to capture the financial sector's exposure to external risks. Precisely, we use two ratios related to the banking system balance sheet: bank foreign assets to total assets and bank foreign liabilities to total assets ratios. While the first ratio mainly captures the extent to which the domestic banking sector can be affected by adverse shocks from international financial markets, the second can be thought as a sort of bank external-debt-coverage-ratio. Government external debt (as a share of GDP) is also included, following the assumption that in emerging markets, a large share of external debt is foreign currency denominated, and fluctuations in the exchange rate generate uncertainties regarding the debt sustainability. Although government debt sustainability will have more broad macroeconomic effects, it may significantly impair the stability of the financial sector by deteriorating the financial institutions' balance sheet (depending on the share of government bonds in domestic financial institutions' total assets). Finally, we assess the effect of financial development, as strong financial development may provide hedging instruments for external transactions, therefore reducing the need for foreign exchange interventions.

As regards the macroeconomic environment, as stated above, we are interested in assessing to what extent some macroeconomic conditions can favor the need to control the exchange rate. In this respect, it can be argued that emerging markets inflation targeters with poorer performances in controlling inflation, and which are more subject to the exchange rate pass-through to inflation, may be more prone to foreign exchange interventions as means to improve their policy achievements. Inflation rate and net imports as a share of GDP (which aims at capturing the exchange rate pass-through) are used to investigate these two issues. We also investigate the effect of the degree of financial and trade openness, relying on the assumption (derived from the "impossible trinity hypothesis") that the most financially open inflation targeting countries may be more inclined to adopt a freely floating exchange rate regime.

Beyond our concern for financial stability, the analysis conducted in this chapter can be related to various strand of the existing literature. To some extent, it examines the extent to which central banks in emerging markets which have adopted inflation targeting tend to face a conflict of objectives (by being tempted to look more closely at the exchange rate) when financial and macroeconomic conditions deteriorate significantly.[87] It may also be related to the literature on the determinants of exchange rate regimes, and the literature on the relative performances of inflation targeting. While the traditional literature on the determinants of exchange rate regimes has mainly focused on the impacts of macroeconomic and structural (institutions, country size, etc.) variables on the exchange rate policy (Klein and Shambaugh, 2010; Rose, 2011, among others), little is known about the interaction between the inflation targeting strategy and the exchange rate regime. In the same vein, the macroeconomic literature on the impact of the inflation targeting adoption has examined its effects on various outcomes such as inflation, fiscal performance, and growth (Vega and Winkelried, 2005; Mishkin and Schmidt-Hebbel 2007; Gonçalves and Salles, 2008; Lin and Ye, 2009; Abo-Zaid and Tuzemen, 2012; Minea and Tapsoba, 2014, among others) but has largely neglected the existence of possible “fear of floating” cases within this group of countries. We show that changes in the financial position and macroeconomic environment determine this outcome.

One of the very few papers which is closely related to this work is Lin (2010) which investigates empirically the link between inflation targeting adoption and volatility of the exchange rate. While Lin’s paper does not look at possible non-linear or conditional effects, it shows that the adoption of inflation targeting has led to higher (lower) volatility of the exchange rate in industrialized (developing) countries. Our empirical analysis expands and complements this work on a number of fronts. First, we are interested in the characteristics of the financial and macroeconomic environment which make targeting countries more prone to deviate from the flexibility commitment they share on average. To answer this question, an empirical framework is proposed which allows testing various conditional variables while addressing the self-selection bias associated with the inflation targeting adoption. Second, we make use of the de facto

[87] In chapter III, our results from estimations of central banks’ reaction functions suggest that in some targeting countries, the main policy instrument (the short term interest rate) responds to exchange rate deviations.

classification of the exchange rate regimes instead of the computed standard deviation of the exchange rate. Ordered models of limited dependent variables as well as average treatment effects from propensity score matching estimators are used to identify the effect of inflation targeting on exchange rate regime, but also factors which may modify this relation.

This work also follows the literature which has demonstrated the extent of "disagreement" between countries' de jure and de facto regimes, and between various existing datasets on exchange rate regime classifications. Rose (2011) documents the stylized facts by showing that existing datasets exhibit a significant level of "disagreement" when classifying countries' exchange rate regimes. More recently, Eichengreen and Razo-Garcia (2013) show empirically that "disagreements" in flexibility between various de facto regimes are not uncommon, and they are not random. They are most prevalent in middle-income (emerging markets) and low-income (developing) countries as opposed to advanced economies. They are also most prevalent for countries with well-developed financial markets, low reserves, and open capital accounts. Our work looks at similar issues but from a different angle. It starts by demonstrating that inflation targeting countries exhibit more flexible de facto exchange rate regime than others. This is not surprising. Then, it confronts the degree of flexibility among targeters against the prevailing financial and macroeconomic environment. It shows that the "disagreement" (the departure from a given level of flexibility) increases following shifts in financial and macroeconomic conditions. These results highlight the difficulty faced by some emerging markets performing under an inflation targeting arrangement in sticking to their commitment.

The chapter is organized as follows. Section II briefly describes the variable capturing the exchange rate regime, the sample, and provides a preliminary discussion regarding our empirical analysis. Section III provides an introductory statistical analysis through a cluster approach. Section IV presents the empirical framework and methodological approaches used to test our main hypotheses. Section V discusses the results. Section VI provides some robustness tests. And section VII concludes.

II. Data and preliminary discussion

The analysis relies on the de facto classification of countries' exchange rate regime as shown in appendix table V.1. The basic classification encompasses several exchange rate arrangements classified into six categories coded from 1 to 6, describing the most fixed (hard peg) and the most flexible regimes respectively. We drop the two last categories (5 and 6), keeping "Freely floating" as the most flexible regime.[88] The empirical test is based on a sample of 36 emerging market countries, including 16 inflation targeters, selected on the basis of data availability (see appendix table V.2). We use annual data over the period 1985 to 2010. Appendix table V.3 provides detailed information regarding the sources of the data and their proper definitions.

We start by assessing the extent to which, above and beyond the common determinants of the exchange rate regime, the monetary policy framework does play a role. Especially, as discussed in the introduction, the exchange rate regime is expected to be more flexible in emerging market inflation targeters, due to the adoption of this monetary policy strategy. It is argued that for the inflation targeting strategy to be effective, and to improve the central bank's credibility regarding its inflation objective, the exchange rate regime in targeting countries should be characterized by no, or very limited interventions on the foreign exchange market. Figure V.1 shows that on average, the correlation between inflation targeting and the flexibility of the de facto exchange rate regime is positive (left chart), suggesting a more flexible exchange rate regime in the sample of targeters compared to their non-targeting counterparts.

When focusing on the sample of targeting countries, the data also shows that the exchange rate regime moves significantly towards more flexibility after the adoption of inflation targeting (figure V.1, right chart). This suggests that full flexibility of the exchange rate regime as a necessary precondition to the implementation of this monetary policy strategy does not hold in emerging markets, because instead they enter more floating regimes later, after the announcement of the inflation targeting adoption. We argue that the extent to which the adoption of inflation targeting is associated with an increase in the flexibility of the exchange rate regime can be

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[88] Note that the 5th category mostly captures hyperinflationary periods, and the 6th category includes countries or periods that cannot be classified due to lack of data availability.

affected by the financial and macroeconomic environment. Some of those financial and macroeconomic factors can favor a move toward more flexibility, while on the contrary others are likely to increase the "fear of floating" in these countries.

Next, we shed light on those factors which can be expected to affect the degree of flexibility of the exchange rate regime among targeting countries. Or, to put it differently, we aim at identifying factors explaining the foreign exchange interventions in emerging markets inflation targeters. As discussed earlier, those interventions (suggesting a deviation from their initial commitment to a freely floating exchange rate regime) can be related to concerns for financial risks, but also to the purpose of improving the stability of the macroeconomic environment. Below, we discuss in further details the relevance of these financial and macroeconomic conditions, and the associated potential risks.

Figure V.1: Average changes in de facto exchange rate regime

For the right chart, 0 on the x-axis indicates the year of inflation targeting adoption. Reinhart and Rogoff data on exchange rate regimes, and Roger (2009).

II.1. The financial conditions

Safeguarding the domestic financial system from external shocks is one of the main reasons for emerging countries' interventions on the foreign exchange market. Higher financial system vulnerability to external shocks increases the likelihood of central bank foreign exchange interventions and reduces the flexibility of the exchange rate regime. In this respect, the "fear of floating" can be understood through the prism of financial stability objectives in emerging markets. Past episodes of financial, banking, sovereign and currency crises in emerging countries could explain why even some inflation targeters are quite cautious in regard to exchange rate flexibility. Let us take for example a country in which the banking system is dominated by subsidiaries of foreign banks or an architecture where mortgage loans are large and issued in foreign currencies. Let us also take another country (or the same country) exhibiting a higher share of public debt denominated in foreign currency or a large share of foreign investors in the domestic debt market. There is an obvious rationale for why these inflation targeters could become less flexible than others. The reason is that under such circumstances even a moderate and unexpected (unhedged) shock to the nominal exchange rate could either worsen banks' balance sheets (higher default on foreign currency denominated mortgages) and public sector debt sustainability could become a major concern.

For the purpose of our empirical investigation, the following factors related to banks' balance sheet, external debt and the degree of financial development are considered.

II.1.a. Banks' balance sheet

Two main ratios capturing the banking sector vulnerability to external shocks allow assessing the effect of banks' balance sheet on exchange rate interventions: the banking sector *foreign assets to total assets*, and *foreign liabilities to total assets*.

The foreign assets to total assets ratio aims to capture the banking sector's exposure to adverse shocks from international financial markets. The higher the share of the domestic banks' total assets invested abroad, the higher the vulnerability of the domestic financial system to negative international financial shocks.[89] More generally, an increase in foreign assets (capital outflows) is usually perceived as potentially destabilizing for the financial sector, especially in emerging countries. The banking sector foreign liabilities to total assets ratio is also interesting to look at, since it may capture another type of external risk related to the banking sector external

[89] The 2008/2009 global financial crisis showed how severely domestic financial sectors can be affected by an international financial shock.

indebtedness as a share of total bank assets. For the particular case of emerging markets, a larger share of banks' foreign liabilities is denominated in foreign currency, posing risks for the domestic financial system in case of large exchange rate shift.

These issues related to the banking sector exposure to external risks may be particularly relevant in emerging markets given the relatively low financial development prevailing in these countries. A higher degree of financial development may provide financial instruments that can help mitigating the negative effects of external shocks. The lack of such financial conditions in emerging markets economies is likely to make central banks more willing to control the exchange rates in order to preserve the domestic financial system from such risks. In this respect, emerging markets inflation targeters with higher external financial vulnerability may be more prone to attempt to stabilize the exchange rate fluctuations, making their exchange rate regimes less floating compared to other targeters. Figure V.2 which examines the correlation between inflation targeting and the exchange rate regime conditional to various macroeconomic and financial conditions shows that targeters with higher ratio of banks foreign liabilities/total assets, have on average a lower flexibility of the their exchange rate regime compared to the others (third panel, right chart). Regarding the bank foreign assets/total assets ratio, the figure depicts a more mixed picture (third panel, left chart).

II.1.b. External debt

As industrialized economies, emerging markets run up debt for government budget financing purposes. However domestic funding is much more limited in emerging countries compared to developed economies. Consequently, external indebtedness in emerging markets remains an important share of the total public debt. Moreover, despite the recent surge in foreign holdings of local-currency government bonds, these countries generally face an inability to borrow abroad in domestic currency (the so-called "original sin") implying that external debt is mostly foreign currency denominated and source of currency mismatches. In such a context, exchange rate flexibility might be viewed as undesirable since it generates increasing uncertainties about the service of the debt, and can derail the fiscal stance. Although the deterioration of the government debt sustainability can have more broad macroeconomic impacts, it may also have meaningful effects on the domestic financial system stability, since a default on the government debt may significantly deteriorate the banking sector balance sheet. This effect can be critical and favor or increase the risk of banking crisis, depending on the relative importance of the share of the government bonds in the banking sector total assets. Indeed, as argued in IMF (2013b), fiscal solvency and sovereign risk can affect the banking the sector through the fact that a rise in the sovereign yields diminishes the value of the public debt held by domestic banks, raising concerns about banks' solvency when they hold large quantity of public debt.[90]

A straightforward implication for our analysis is that inflation targeters with higher total external debt (as a share of GDP)[91] will seek to intervene more frequently than other targeting countries to better control the nominal exchange rate in order to prevent the related risks. As shown in figure V.2 (first panel, left chart), when the targeting country sample is divided into groups of countries with high external debt versus others, the exchange rate regime is skewed towards rigidity and flexibility, respectively. These correlations imply that higher external debt (foreign currency-denominated debt) is associated with the "fear of floating", making targeting countries abandon their initial commitment to full flexibility.

II.1.c. Financial development

As mentioned above, the degree of financial development can mitigate the risks related to exchange rate fluctuations, by providing hedging instruments (Aghion et al., 2009). In this regard, inflation targeters with the most developed financial sectors may be less inclined to control the exchange rate for financial stability purposes. Moreover, financial development improves the transmission mechanisms of monetary policy, making it more likely that there is an independent monetary authority which therefore is likely to operate in more flexible exchange rate regimes. Greater financial development is also a necessary pre-requisite for an effective and efficient inflation targeting strategy. Targeters with well-developed financial sectors can be

[90] Note that baking sector instability may in turn affect the fiscal stance, since systemic banking sector problems may raise concerns for fiscal solvency. A sovereign-bank feedback loop may therefore emerge.

[91] As an alternative measure, we consider the total external debt as a share of exports receipts on goods and services, and that does not change the results.

expected to perform better in meeting their objectives and will be certainly less prone to intervene to control the exchange rate. As stated in Stone et al. (2009), financial development improves policy implementation by reducing the need to depend on foreign exchange interventions.

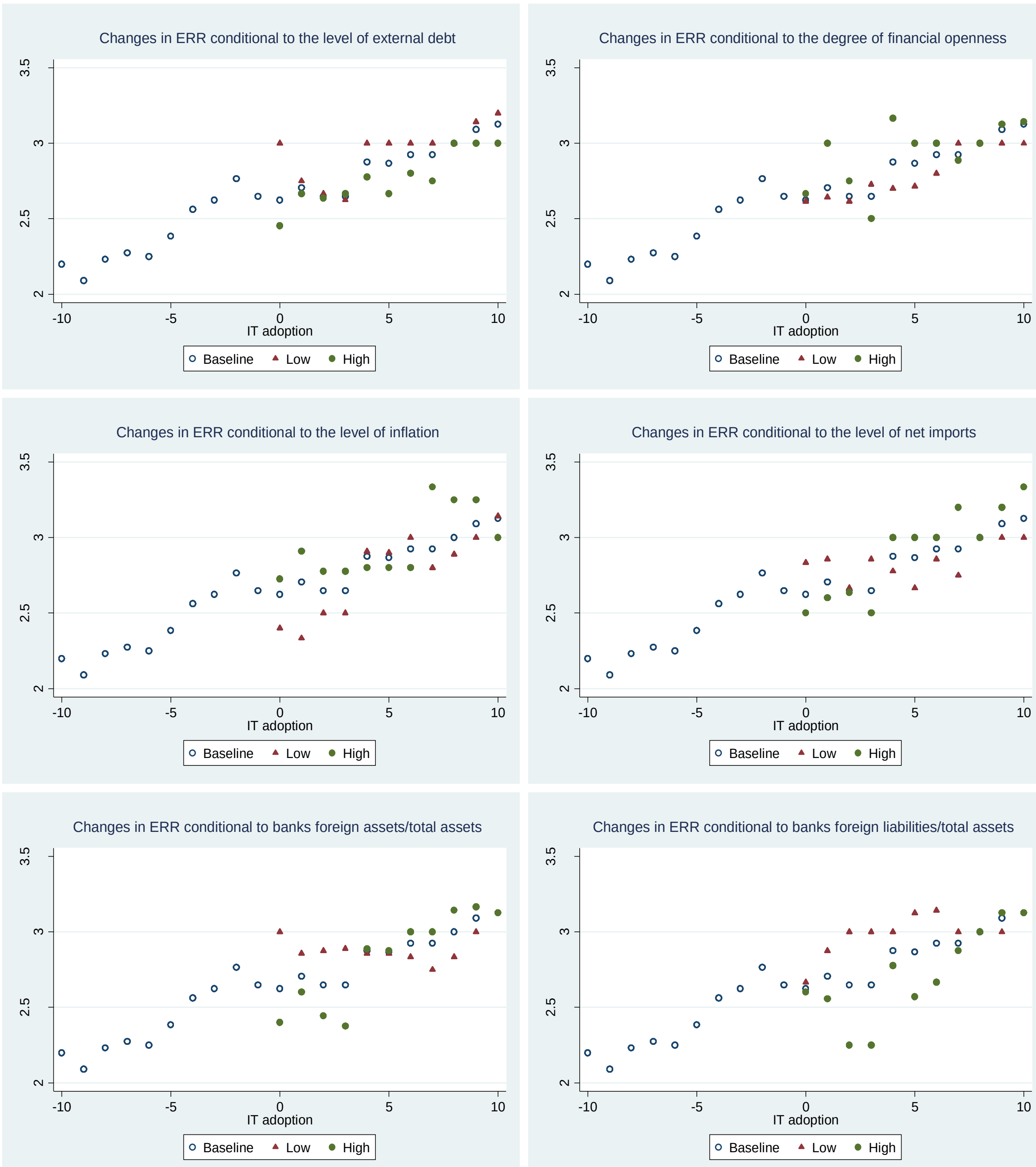
II.2. Inflation and exchange rate pass-through

Achievements regarding the control of inflation are certainly less conclusive in emerging countries (compared to high income economies). This has to do with domestic macroeconomic and institutional conditions, but also with their higher vulnerability to external shocks. Indeed, considering for example a country highly dependent on imports of goods and services from abroad, and assuming that the exchange rate pass-through is positively correlated with the degree of trade openness, sharp fluctuations of the country's bilateral exchange rate with key trading partners could have tremendous macroeconomic implications on the real economy. Some central banks might therefore find it more effective intervening in the foreign exchange market to stabilize the exchange rate with the aim of controlling the inflation rate.

Inflation rate

Although emerging market inflation targeters perform better in stabilizing inflation than their peers (see for example Vega and Winkelried, 2005; Mishkin and Schmidt-Hebbel 2007, Gonçalves and Salles, 2008; and Lin and Ye, 2009), they often miss the announced inflation targets over protracted periods of time. The monetary policy-making relying on the short term interest rate as the main policy instrument is likely to be less effective in those countries, given their higher vulnerability to exchange rate shocks. As a result, emerging market inflation targeters with poorer track records in stabilizing inflation (high inflation rates) will be more prone to manipulate the exchange rate in order to cope with potential external shocks and to improve their inflation performances, especially in countries where the exchange rate pass-through is assessed as high and where monetary policy transmission is weak. So the exchange rate regime is less likely to be freely floating in those countries, compared to targeters which perform better in meeting their inflation objective.

<u>Figure V.2</u>: Average changes in de facto exchange rate regime conditional to financial and macroeconomic conditions



For each macroeconomic or financial variable “Low” repesents inflation targeting observations below the median, while “High” captures inflation targeting observations above the median . 0 on the x-axis indicates the year of inflation targeting adoption. Authors’ calculations based on Reinhart and Rogoff classification of exchange rate reimes; IMF World Economic Outlook and International Financial Statistics; Roger (2009); Lane and Milesi-Ferretti (2011).

Net imports

It is assumed that the higher the net imports (as a share of GDP), the stronger the pass-through of imported inflation pressure. The external position and the potential imported inflation exacerbate the difficulty in controlling and stabilizing inflation around the official target. In this respect, inflation targeting countries which are relatively more subject to exchange rate pass-through (higher imported inflation) may be more likely to control exchange rate fluctuations. Consequently, the exchange rate regime will be less flexible in those countries compared to the others.

The preliminary statistical analysis of the correlation between inflation targeting and exchange rate regime conditional on the level of inflation and net imports, as presented in figure V.2 (middle panel) seems to be rather mixed.

II.3. Economic openness

The degree of economic openness is another important determinant which may explain differences in the degree of flexibility of exchange rate regimes among emerging market inflation targeters. Here we mainly focus on trade and financial openness.

According to the "impossible trinity" hypothesis, the three objectives of independent monetary policy, capital mobility, and exchange rate stabilization cannot be achieved simultaneously. Since central bank independence is a crucial precondition for the adoption of the inflation targeting strategy, and given that emerging market inflation targeters are, on average, more financially integrated into the global financial system (suggesting a greater financial openness), their ability to maintain a stable exchange rate will be more restricted. In this respect, more financially open inflation targeters are expected to have less room for exchange rate control (it would be too costly in terms of foreign exchange reserves management), and so to move towards more flexible exchange rate regimes.[92] We argue that trade openness, may work in the same way.

[92] We used a de facto index of financial openness, calculated as the sum of external financial assets and liabilities in percentage of GDP.

In figure V.2 (first panel, right chart), financial openness (here capturing a wide range of indicators of the degree of capital mobility) indeed seems to matter for the flexibility of the exchange rate. The exchange rate regime seems to be more flexible in countries that impose fewer restrictions on international capital mobility, suggesting a clear and perhaps stronger policy commitment to both financial integration and macroeconomic adjustment through exchange rate flexibility. It also validates the “impossible trinity” hypothesis whereby countries seeking to fully take advantage of an independent monetary policy (*e.g.* the targeters) and allowing capital mobility cannot afford to control closely the level of the nominal exchange rate.

III. Statistical analysis: a cluster approach

Before turning to the empirical investigation, this section provides a preliminary statistical analysis based on a clustering approach. The purpose is to rely on the financial and macroeconomic characteristics discussed above to assess the extent to which they determine a certain degree of heterogeneity among inflation targeters.

We use a hierarchical clustering analysis built upon an agglomerative procedure. To briefly describe this approach, it hierarchically agglomerates a given sample of units (here our targeting country sample) by grouping together units which are the most close to each other, based on some specified characteristics (financial and macroeconomic conditions, in our case). The algorithm also automatically determine the optimal number of clusters, *i.e.* the optimal number of groups within which units present similar characteristics. The dissimilarity between each pair of units is defined here by the Euclidean distance.[93] And to determine whether another unit or another group of units should be linked to a first group to form a cluster, the commonly used

[93] The Euclidean distance can be described through the following equation: $d^2(i,l)=\sum_{k=1}^{K}(x_{ik}-x_{lk})^2$, where x_{ik} and x_{lk} are values of the variable *k* (the characteristics) for country *i* and *l*, respectively.

Ward method is implemented (Ward, 1963).[94] The clustering analysis is performed on two sub-periods (ten years before and after the inflation targeting adoption), and it is based on the exchange rate flexibility and two set of characteristics: financial conditions (including the two ratios related to the banks' balance sheet as described above, external debt and financial development), and macroeconomic conditions (including inflation, net imports, trade and financial openness).

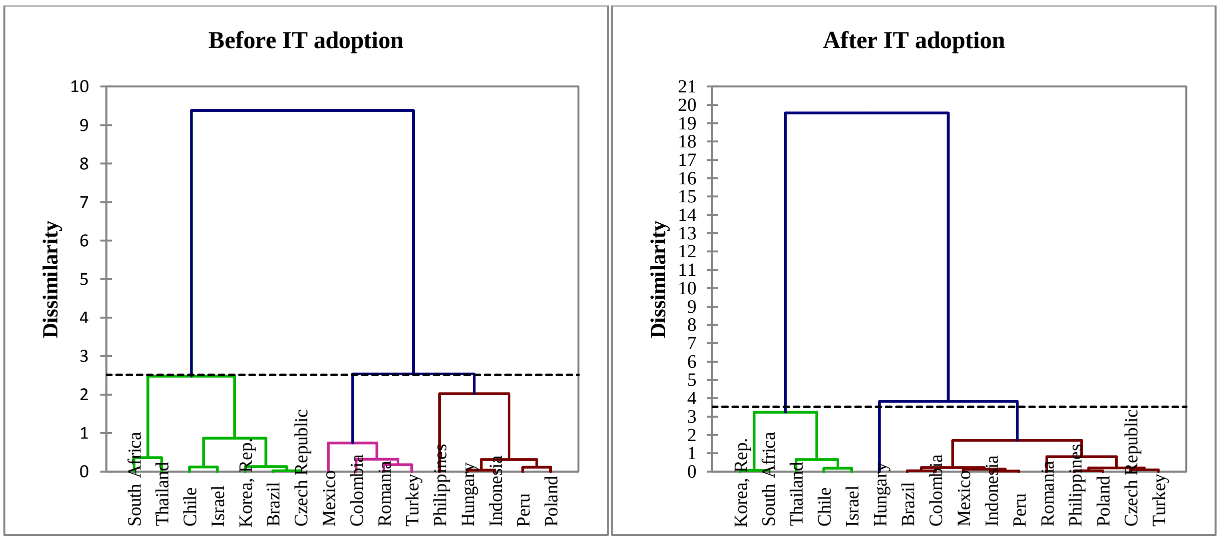
Figure V.3 shows the resulting dendrograms based on financial conditions. These results suggest that the heterogeneity between emerging market targeters is lower after the adoption of inflation targeting. Indeed, the dendrogram shows 3 clusters consisting of 7, 4 and 5 countries before the implementation of the inflation targeting regime. The period following the adoption rather exhibits 2 main clusters consisting of 10 and 5 countries (a third cluster exists, but only includes one country). However, the heterogeneity between clusters has significantly increased in the post-adoption period, as shown by the degree of dissimilarity (vertical axis). This may indicate clusters characterized by more or less sound financial conditions. Following our discussion above, countries with less good financial positions are expected to be more inclined to foreign exchange interventions, reducing the flexibility of the exchange rate regime.

To further shed light on this issue, table V.1 provides the barycenter corresponding to each characteristic and for each cluster when considering the post-adoption period. These statistics are interesting since they show that the cluster with the higher level of exchange rate flexibility (the 2nd cluster) is also the one that is characterized by the best financial conditions (lowest levels of external debt and the banks' balance sheet ratios, and strongest financial development). On the contrary, the other clusters characterized by poorer financial conditions show lower flexibility of

[94] The Ward procedure is based on the following variance decomposition: $\sum_{k=1}^{K}\sum_{q=1}^{Q}\sum_{i=1}^{N_q}(x_{iqk}-\overline{x}_k)^2=\sum_{k=1}^{K}\sum_{q=1}^{Q}N_q(\overline{x}_{qk}-\overline{x}_k)^2+\sum_{k=1}^{K}\sum_{q=1}^{Q}\sum_{i=1}^{N_q}(x_{iqk}-\overline{x}_{qk})^2$, where x_{iqk} is the value of the variable k for country i in cluster q, the $\overline{x}$ s describe mean values of x, N_q is the number of country in the cluster q. The total variance is decomposed into the between and within variances. When referring to such a procedure, the best clustering process is the one that minimizes the within-cluster variance, while maximizing the between-cluster variance.

their exchange rate regime, suggesting more foreign exchange interventions. These preliminary findings are in line with our previous discussion and highlight the relevance of the chosen financial indicators in determining the exchange rate flexibility.

Figure V.3: Dendrogram based on financial conditions before and after the IT adoption



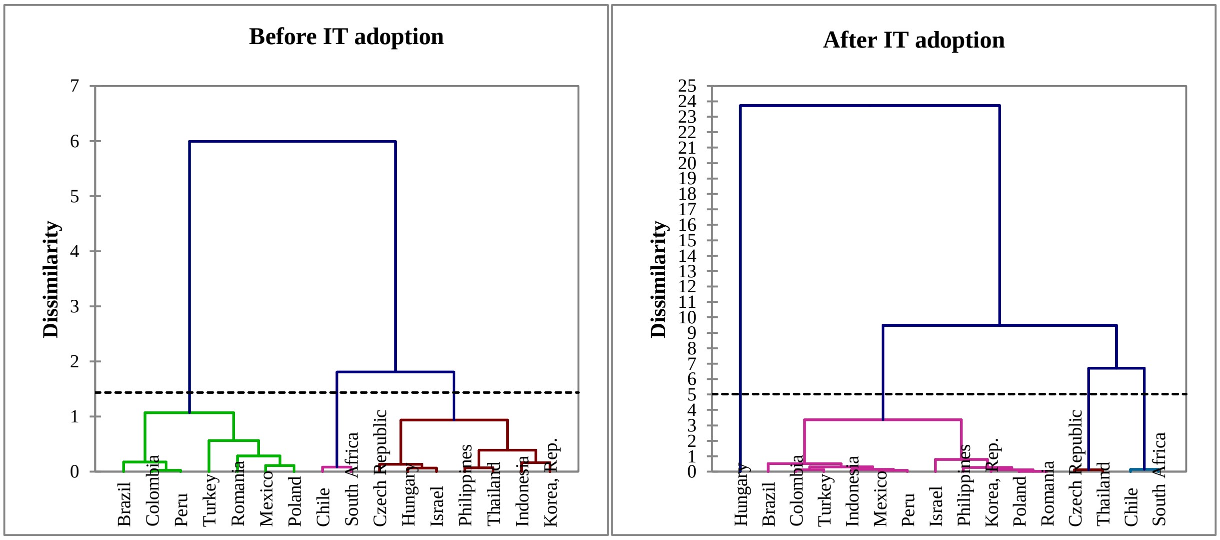
Clustering analysis for emerging market inflation targeters, based on financial conditions (Ward's agglomerative algorithm). The dotted lines allow determining the optimal number of cluster.

Table V.1: Barycenter of clusters for the post-IT period, considering the financial conditions

Cluster	External debt (%GDP)	Bank foreign assets to total assets	Bank foreign liabilities to total assets	Financial development	Exchange rate flexibility
1	38.162	9.324	12.519	32.604	2.812
2	37.543	9.030	9.051	109.633	3.069
3	97.793	12.439	25.723	54.586	2.600

Turning to the macroeconomic conditions, figure V.4 shows the dendrograms for the two sub-periods considered. Conclusions regarding the sample heterogeneity are in line with those related to the financial characteristics. The period following the adoption of inflation targeting shows higher homogeneity between targeting countries, compared to the pre-adoption period (the latter encompasses 3 clusters consisting of 7, 2 and 7 countries, while the former shows one main cluster consisting of 11 countries, two clusters of 2 countries, and last one with 1 country). However, the figure also evidences that the dissimilarity between clusters has significantly increased in the post-adoption period.

Figure V.4: Dendrogram based on macroeconomic conditions before and after the IT adoption



Clustering analysis for emerging market inflation targeters, based on macroeconomic conditions (Ward's agglomerative algorithm). The dotted lines allow determining the optimal number of cluster.

Table V.2: Barycenter of clusters for the post-IT period, considering the macroeconomic conditions

Cluster	Trade openness	Inflation rate	Financial openness	Net imports	Exchange rate flexibility
1	60,205	5,354	42,408	0,376	2,833
2	63,343	4,627	110,282	-1,638	3,458
3	129,349	2,887	62,025	-5,555	2,692
4	148,997	5,637	192,101	-0,115	2,600

When looking at the barycenter corresponding to each variable considered and for each cluster (table V.2), conclusions are more mixed compared to the previous case. The cluster which exhibits the highest level of exchange rate flexibility is mostly characterized by a relatively higher degree of financial openness, lower inflation and lower dependence on imports. The others are characterized by less good inflation performances, higher dependence on imports, but higher trade openness. Drawing the line regarding foreign exchange interventions is less straightforward in this case. The next section describes the empirical frameworks which are used to assess the effect of each of those macroeconomic and financial characteristics.

IV. Empirical framework

In this section, we introduce the econometric framework used to test the hypotheses discussed above. The empirical analysis relies on two main approaches: limited dependent variable models (ordered probit estimates), and impact evaluation technics (propensity scores matching). The two approaches are presented successively in the subsequent subsections.

VI.1. Panel ordered probit model

The choice of an exchange rate regime by country i in period t is described using a discrete variable y_{it} which, as discussed above, can take four values from 1 to 4 (higher values indicating greater flexibility). y_{it} = 1 captures the less flexible regime (peg), and y_{it} = 4 the most flexible regime (freely floating). This choice is based on a latent variable y_{it}^* which is a function of economic and institutional determinants of the exchange rate regime. It is assumed that a country chooses a specific regime if the latent variable falls below, within or above certain thresholds (c_1, c_2 and c_3) as follows:

$$y_{it} = \begin{cases} 1, & if\ y_{it}^* < c_1 \\ 2, & if\ c_1 < y_{it}^* < c_2 \\ 3, & if\ c_2 < y_{it}^* < c_3 \\ 4, & if\ y_{it}^* > c_3 \end{cases}$$

with $c_1 < c_2 < c_3$. These unknown thresholds are to be estimated along with the other parameters of the model which takes the form of:

$$y_{it}^{*} = X_{it}^{'}\beta + \alpha IT_{it} + \delta IT_{it} * \tilde{z}_{it} + \varphi z_{it} + \varepsilon_{it} \qquad \text{for } i=1, 2 \ldots N \text{ and } t=1, 2 \ldots T_i \qquad (1)$$

where X_{it} is the vector of the most common determinants of the exchange rate regime, IT_{it} is a dummy variable equal to 1 for country i in period t if the country is classified as an inflation targeter and 0 otherwise, z_{it} is a conditional variable that is expected to modify the effect of IT on the exchange rate regime (with $\tilde{z}_{it}$ the difference between z_{it} and its sample mean),[95] and ε_{it} is an error term which is assumed to follow a logistic or normal distribution. N is the number of countries and T_i the total number of observations available for country i. Equation (1) therefore describes the structure of our estimated model and we are particularly interested in the effect of inflation targeting on the exchange rate regime, but more importantly the extent to which this effect may be modified by financial and macroeconomic conditions. Ordered latent models are used (ordered probit or logit) and country-specific effects are controlled for by the means of random effects.

Standard determinants of the exchange rate regime (vector X)

Relying on the existing literature (Edwards, 1996; Rizzo, 1998; Méon and Rizzo, 2002; von Hagen and Zhou, 2005; Markiewicz, 2006; von Hagen and Zhou, 2007; Güçlü, 2008, among others), we control for a set of nine variables considered as common determinants of the choice of an exchange rate regime. These include:

Trade openness, our proxy for trade openness is defined as the sum of a country's exports and imports as a percentage of GDP. The traditional approach based on the theory of optimum currency areas (Mundell, 1961; McKinnon, 1963) suggests that pegged regimes are more suitable for countries characterized by high trade openness because a stable exchange rate facilitates trade. In this respect, *Trade* is expected to be negatively correlated with our measure of exchange rate flexibility.

[95] This specification is used to reduce the co-linearity between the interaction term and z_{it}, but also to ease the interpretation of the interaction.

Ka_open is an index measuring capital mobility. Just as for trade, emerging countries with higher capital openness can be expected to attempt to control exchange rate fluctuations since this will provide better stability in the international financial transactions and will help safeguard their financial system.

Economic_dvlpt captures the country's economic development as measured by the log of real GDP per capita in constant U.S. dollar. The costs associated with the creation and the maintenance of a central bank with an independent monetary policy will be higher in least developed countries compared to countries that have greater economic development. In addition, the optimum currency areas theory predicts that more developed countries are more likely to float. Consequently, higher economic development is expected to increase the probability to adopt and maintain a flexible exchange rate regime.

Growth measures the annual growth of GDP and aims to control for countries' economic growth or business cycle conditions. As suggested by Edwards (1996), the growth in GDP can provide indications about countries' real economic "ambition", for example regarding the reduction of unemployment. In this sense, countries with higher "ambition" (countries that grow faster) will tend to tie their hand by adopting fixed exchange rate regimes to solve the potential credibility problem. It may also be argued that a country which grows faster compared to its main partners will find it less easy to maintain such an economic expansion if not able to control its external account balance. And the latter is likely to be more easily manageable within a pegged exchange rate regime. Furthermore, good economic performances can be expected to favor the accumulation of foreign exchange reserves, necessary to maintain a fixed regime. These arguments all suggest that *Growth* is expected to be negatively correlated with exchange rate flexibility.

Financial_dvlpt captures the degree of financial development. Low financial development should be associated with less flexible regimes because countries with less sophisticated financial sectors will lack the necessary infrastructures for monetary authorities to conduct open market operations. The banking system credit provided to the private sector (as a share of GDP) is used as proxy for financial development.

Inflation is the annual rate of growth of the consumer price index. Large increases in inflation or significant inflation shocks make fixed exchange rate regimes less sustainable and require exchange rate adjustments to realign the relative prices. As a consequence, highly inflationary economies will be less inclined to keep fixed exchange rate regimes. Therefore, *Inflation* is expected to reduce the probability of adopting a flexible exchange rate regime.

Reserve is our measure of international exchange reserves coverage (total reserves in months of imports) and is expected to be negatively correlated with the probability of adopting a flexible exchange rate regime. The availability of foreign exchange reserves is particularly important for the viability and the credibility of pegged exchange rate regimes, as it provides the monetary authorities with some room to maintain the parity in case of shocks.

Fiscal is a variable which captures the country's fiscal position. In particular, we control for the change in total government debt as a percentage of GDP, which is considered as a proxy for the public deficit as a share of GDP.[96] An increase in the fiscal deficit increases the domestic interest rate and consequently, makes it less easy to maintain fixed exchange rate parity. A higher fiscal deficit can be expected to reduce the probability to fix.

Politics is an index political stability. It is introduced in our estimated model following Edwards (1996), and Méon and Rizzo (2002) who show that the political environment can play an important role in determining the choice of an exchange rate regime. In particular these two papers find that countries with high political instability are less likely to adopt a fixed exchange rate regime. This control variable is therefore expected to have a negative effect on our dependent variable measuring the degree of flexibility of the exchange rate regime.

The conditional variables (z)

In equation (1) the effect of inflation targeting is expected to be positive, suggesting that on average the exchange rate regime is more flexible in emerging market inflation targeters, compared to their non-targeting counterparts. However, we argue that this positive correlation is

[96] We use the change in government debt because these data are more available (in terms of time dimension and sample coverage) than fiscal surplus/deficit data.

likely to be modified by some financial and macroeconomic characteristics (captured by the interaction terms in our empirical framework). Particularly, from equation (1), and assuming a specification relying on a linear probability model, the marginal impact of *IT* is derived as follows:

$$\frac{\partial y_{it}^*}{\partial IT_{it}} = \alpha + \delta \tilde{z}_{it}$$

This expression gives the effect of inflation targeting for targeters whose z_{it} deviates from the sample mean, while α captures the effect of inflation targeting for targeters whose z_{it} is equal to the mean ($\tilde{z}_{it} = 0$).

First, following our discussion in the previous section, if we consider financial and macroeconomic characteristics which can make targeters more likely to intervene on the foreign exchange rate market, therefore reducing the probability to adopt a freely floating exchange rate regime, these may include *Bank foreign assets to total assets ratio*, *Bank foreign liabilities to total assets ratio*, E*xternal debt*, *Inflation rate*, and *Net imports* (factors reducing the positive effect of *IT* on exchange rate flexibility). Considering those factors as conditional variables in our empirical framework, δ is expected to be negative, suggesting lower flexibility of the exchange rate regime in inflation targeting countries, and consequently, more frequent foreign exchange interventions.

Next, some other characteristics of inflation targeting countries can be expected to strengthen the choice of a more flexible exchange rate regime (factors reinforcing the effect of *IT* on exchange rate flexibility). Also following our previous discussion, these factors include *Financial development*, *Trade*, and *Financial openness*. With these factors as conditional variables, δ is expected to be positive, suggesting higher exchange rate flexibility in inflation targeting countries.

In addition to the above financial and macroeconomic features, the following factors may also play a role in determining the relative degree of exchange rate flexibility:

Time - the length of time since the adoption of inflation targeting

Most emerging markets implementing the inflation targeting monetary policy strategy do not satisfy the required preconditions at the time of the adoption of this strategy. Consequently, due to the lack of sound initial macroeconomic and institutional conditions, these countries tend to remain in relatively fixed or managed floating exchange rate regimes, even after the public announcement of the adoption of inflation targeting. They then move to more flexible regimes later, when these conditions improve (see appendix figure V.1). This suggests that, countries that have implemented inflation targeting for a longer period of time may be more favorable to exchange rate flexibility, compared to countries that have adopted the strategy more recently. Stone et al. (2009) support this argument for emerging countries by highlighting the role of the exchange rate during the transition to a full-fledged inflation targeting framework.

The probability of adopting inflation targeting

Adopting inflation targeting as a monetary policy framework should increase the probability of having a flexible exchange rate regime. However, it can be argued that those countries that better meet the preconditions for this policy adoption may be more prone to exchange rate flexibility in the first place. Following Lin and Ye (2009), we test this hypothesis by interacting the *IT* dummy with the *Pscore* which is the predicted probability of adopting inflation targeting explained by a large set of pre-determined macroeconomic conditions (the higher the *Pscore*, the better the preconditions are met). The estimation of the *Pscores* is discussed in more details in section IV.2.

IV.2. Propensity score matching

As discussed previously in chapter III, an issue in empirical analyses which seek to compare targeting and non-targeting countries is the obvious self-selection bias surrounding the adoption and the implementation of the inflation targeting regime. The choice of adopting a particular monetary policy strategy such as inflation targeting is not random, and may depend on a country's macroeconomic and institutional characteristics (prerequisites for a successful and credible regime). Ignoring or failing to take this bias into account could result in severe biases in the estimates. But also, addressing or limiting the extent of the bias is a herculean task in the absence of natural experiments, credible instrumental variables, or a pure randomized control strategy. We follow the literature on macro impact evaluations and make use of the propensity score matching technic (PSM). Earlier papers focusing on the macroeconomic consequences of the adoption of inflation targeting have provided robust estimates using this framework (Vega and Winkelried, 2005; Lin and Ye, 2007; Lin, 2010, among others).

We are interested in evaluating the effect of a treatment (the implementation of the inflation targeting regime) on the treated (the group of inflation targeting countries) regarding a specific outcome (the degree of exchange rate regime flexibility). As shown in chapter III, the PSM approach allows estimating the effect of inflation targeting as follows:

$$ATT = E\left[Y_i^1 \mid T_i = 1,\, p(W_i)\right] - E\left[Y_i^0 \mid T_i = 0,\, p(W_i)\right] \qquad (2)$$

where *ATT* designates the average treatment effect on the treated, and *T* is a dummy variable equal to 1 for an inflation targeting country and 0 otherwise. The expression $Y_i^1 \mid T_i = 1$ represents the value of the outcome observed for an inflation targeter, and $Y_i^0 \mid T_i = 1$ is the value of this outcome if the country had not adopted inflation targeting. The PSM is based on the fundamental assumption that, conditional on certain observable characteristics *W*, the outcome should be independent of the treatment $(Y^0, Y^1 \perp T \mid W)$. Assuming the independence condition, the PSM implies matching treated and non-treated on the basis of a score derived as the probability of policy adoption conditional on *W* (the propensity scores). $p(W_i) = \Pr(T_i = 1 \mid W_i)$ is therefore the probability of adopting inflation targeting, which can be estimated using probit or logit models.

Also following our description of this methodology and the existing literature, we consider a variety of propensity score matching algorithms: nearest neighbor matching, radius matching, and kernel matching. For the nearest neighbor matching method, three alternatives are tested: the nearest neighbor, the 3 nearest neighbors and the 5 nearest neighbors. The radius matching method also relies on three alternative sizes of the radius (*r*): *r*=0.1, *r*=0.05 and *r*= 0.02.

For the purpose of estimating the propensity scores, we use a probit model in which the dependent variable is the inflation targeting dummy. The explanatory variables (*W*) are factors which affect both the adoption of inflation targeting and the degree of exchange rate regime flexibility (we control for macroeconomic characteristics affecting both the treatment and the outcome): one year lagged inflation rate, trade openness, GDP growth, foreign exchange reserves, fiscal deficit, economic development, financial development, and central bank independence. We expect the last three variables to be positively correlated with the probability of adopting inflation targeting, and the others negatively.

In this framework, to investigate the extent to which the effect of *IT* on the exchange rate regime is affected by financial and macroeconomic conditions (the conditional variables *z*) discussed above, we rely on the following simple approach. Considering the sample of targeters, we determine a threshold level of the conditional variable *z* (let us say its median value) and split the targeting observations into two groups (above and below the threshold). We then estimate the *ATT* for the two groups separately, the non-targeters sample remaining unchanged and forms part of the control groups. The *ATT* is expected to be different between the two groups depending on the levels of *z*. More precisely, let us consider the case where *z* is external debt. The *ATT* is expected to be lower for the group of targeters which have higher external debt (above the median), suggesting that the exchange rate regime is less flexible in those countries and highlighting more frequent foreign exchange interventions, with respect to those whose levels of debt is lower (below the median).

V. Results

This section presents and discusses the main results from two alternative econometric approaches described in the previous section. The findings from ordered probit estimates are provided, before we turn to results from the matching method.

V.1. Results from ordered probit

Since the values taken by our dependent variable (the choice of an exchange rate regime) can be ordered logically (from fixed to flexible), equation (1) is estimated using random-effects ordered probit to control for unobserved country-specific heterogeneity. All explanatory variables (except the *IT* dummy) are included with one year lag to reduce the potential bias due to reverse causality.[97]

From table V.3, the results suggest that most of the coefficients associated with the standard determinants of the exchange rate regime appear to be significant with the expected sign. Among the most relevant variables, trade openness, economic growth, foreign exchange reserves, and financial openness are found to have a negative effect on the probability of adopting a flexible exchange rate regime. In other words, in emerging countries, an increase in these variables will favor pegged exchange rate regimes. On the contrary, the findings show that inflation rate is positively correlated with the probability of adopting more flexible regimes. As discussed above, high inflation impairs the sustainability of pegs and can generate large costs arising from the required exchange rate adjustments. Therefore, increasing inflation will tend to be associated with more flexible regimes. The effect of these determinants proves to be robust to the various specifications of the estimated model presented in table V.3.

Economic development and political stability also affect the choice of the exchange rate regime, although their effects are much less robust to alternative model specifications. The increase in countries' economic development is associated with a higher probability to adopt more flexible regimes. On the contrary, political stability seems to favor pegs, since it is found to have a negative effect on exchange rate flexibility. The coefficients associated with financial development and public deficit are not statistically significant, suggesting that these factors are not relevant in determining the exchange rate regime.

Our results regarding the standard determinants of exchange rate regime are consistent with the theoretical argumentation and broadly in line with previous empirical works. Now let us turn to the main interest of the chapter which is inflation targeting and associated conditional effects.

The effect of the *IT* dummy is almost always strongly significant and positive, suggesting that the adoption of the inflation targeting strategy increases the probability of having a flexible exchange rate regime. That is to say, on average, targeters float relatively more than non-targeters.

[97] Since we are not interested in measuring the magnitude of the effect of inflation targeting on the exchange rate regime, but rather the sense of the causality, we do not derive the marginal effects from the probit and logit models.

We now examine the existence of possible non-linearities in the effect of the inflation targeting strategy on the choice of the exchange rate regime. As discussed in section II and section III, financial and macroeconomic conditions can explain why some targeting countries are more or less inclined to foreign exchange interventions.

Let us start with the effect of financial conditions. Table V.3 shows that the coefficients associated with the interaction terms between *IT* and *Bank foreign assets/total assets*, *Bank foreign liabilities/total assets* ratios, and *External debt*, all exhibit strong significant but negative effects (columns 5, 6 and 9). The negative signs associated with these interactions suggest that emerging markets inflation targeters with high levels of external debt, bank foreign assets/total assets and bank foreign liabilities/total assets are less likely to have a freely floating exchange rate regime, compared to other targeters. We argued that a high level of external debt (especially foreign currency denominated debt), may generate more concerns regarding exchange rate fluctuations, making targeters more prone to attempt to stabilize the exchange rate. Indeed, high exchange rate fluctuations engender increasing uncertainties regarding the debt service, generating concerns about debt sustainability with potential important consequences for the financial sector and the overall macroeconomic environment.

The banking sector balance sheet exposure to external shocks and currency mismatch is another particularly important issue in emerging countries. Our finding shows that those targeters whose banking sectors are the most vulnerable to such risks are more prone to foreign exchange interventions, than the others.[98] Overall, these findings from the empirical investigations are in line with our argumentation that emerging markets inflation targeters which are more financially vulnerable to external risks do intervene more frequently on the foreign exchange market to control the exchange rate, and are consequently less likely to have a freely floating exchange rate regime. These countries therefore rely on foreign exchange interventions as an instrument to

[98] Note that as an alternative to the two ratios related to the banking system balance sheet used in this empirical exercise, we test the interaction terms between IT and the growth rate of bank foreign assets and the growth rate of bank foreign liabilities. The findings support our conclusions that higher exposure of the financial system to external shocks (higher growth rates) is associated with lower flexibility of the exchange rate regime in inflation targeting countries.

improve the stability of their financial sector or to preserve their financial system from potential crises.

Compared to the above three variables capturing a possible deterioration in the financial stance, we argue that the degree of financial development may play in the opposite way. The empirical results show that the interaction term between *IT* and *Financial development* exhibits a positive and significant effect at the 1 percent significance level (column 4). This positive effect suggests that for targeters whose financial development is above the sample average, the flexibility of the exchange rate regime is higher. The degree of financial development can improve the external financial position with regard to risk, by providing hedging instruments for international transactions. By so doing, it can reduce need for foreign exchange interventions (as a prudential instrument). The degree of financial development also improves the effectiveness of inflation targeting by facilitating the transmission mechanisms of monetary policy, making it less necessary to control the exchange rate (as a means of policy adjustment for the monetary authority). A related argument, which may be more relevant for emerging countries, has to do with the financing needs. A stronger financial development is likely to be associated with higher domestic saving, therefore reducing the country's dependence to external funding and the related vulnerability to exchange rate fluctuations. In such a context, the authorities can be expected to be less prone to attempt to control the exchange rate. Our result seems to support this argumentation.

Let us now turn to the role of countries' inflation performances and exchange rate pass-through. The interaction terms between *IT* and *Inflation*, and between *IT* and *Net imports* exhibit strong significant and negative effects (columns 7 and 8). This suggests that targeters with levels of inflation and net imports above the sample average exhibit a lower flexibility of the exchange rate, compared to other inflation targeting countries. Targeters may be willing to control the exchange rate fluctuations if they are highly dependent on imports, since this makes the domestic economy more vulnerable to international price shocks and is associated with a higher exchange rate pass-through. As regards the level of inflation, if an inflation targeting central bank faces trouble in achieving its inflation stabilization objective, it may be willing to control the exchange rate fluctuations in order to limit the size of the exchange rate pass-through into inflation and ultimately improve its policy achievements.[99]

As regards economic openness, table V.3 shows that coefficients associated with interactions between *IT* and *Trade openness*, and between *IT* and *Financial openness* are both positive and significant at the 1 percent significance level (columns 2 and 3). While implementing inflation targeting increases the flexibility of the exchange rate regime, this result suggests that inflation targeters which are on average more open financially and economically, float more than the others. As discussed above, this can be related to the "impossible trinity" hypothesis which suggests that an independent monetary policy coupled with (relatively) free mobility of international capital is incompatible with a pegged exchange rate regime. As a consequence, the higher the openness of targeter's capital accounts, the higher the probability of floating.

Finally, we investigate whether the effect of the inflation targeting strategy on the choice of an exchange rate regime varies with the probability of adopting this monetary policy framework, and with the maturity of the targeting strategy in place. The coefficients associated with the interaction terms between *IT*, *Pscore* (the probability of adopting inflation targeting), and *Time* (the number of year since the adoption of the inflation targeting strategy), are positive and significant (columns 10 and 11).[100] Targeters which better meet the preconditions of policy adoption (with a *Pscore* higher than the sample average) are more likely to float. Also, a long-standing implementation of the inflation targeting strategy increases the probability to float. This can be perceived as a "learning-by-doing" effect in practicing the policy.

[99] Note that we also test the interaction between *IT* and inflation volatility and we reach the same conclusion: the interaction term exhibits a negative and significant effect, suggesting that targeters with higher inflation volatility intervene more frequently on the foreign exchange market, and consequently have a lower probability to adopt a freely floating exchange rate regime.

[100] While the general rule requires that both interacted variables should be included in the regression, we do not include *Time* because its values are the same as those of the interaction term.

Table V.3: Random effects ordered probit estimates

	Dependent variable : de facto exchange rate regime										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10	(11)
Trade openness	-0.00529*	-0.00895***	-0.000808	-0.00497	-0.00518	-0.00605*	-0.00560*		-0.00574	-0.00628*	-0.00687**
	(-1.719)	(-2.627)	(-0.214)	(-1.573)	(-1.642)	(-1.915)	(-1.787)		(-1.502)	(-1.875)	(-2.142)
Growth	-0.0343**	-0.0372**	-0.0368**	-0.0341**	-0.0359**	-0.0363**	-0.0357**	-0.0272*	-0.0218	-0.0472***	-0.0329**
	(-2.309)	(-2.499)	(-2.444)	(-2.283)	(-2.300)	(-2.319)	(-2.393)	(-1.688)	(-1.384)	(-2.671)	(-2.189)
Economic_dvlpt	0.182	0.206	0.259	0.217	0.114	0.0747	0.191	-0.0806	0.440*	0.357*	0.0883
	(0.934)	(1.051)	(1.252)	(1.060)	(0.557)	(0.363)	(0.954)	(-0.352)	(1.647)	(1.657)	(0.447)
Financial_dvlpt	8.21e-05	0.000269	0.000538	-0.00717*	0.000444	0.00164	-0.00122	-0.000160	-0.00303	0.000818	-0.00189
	(0.0221)	(0.0721)	(0.142)	(-1.657)	(0.118)	(0.433)	(-0.323)	(-0.0407)	(-0.707)	(0.202)	(-0.497)
Inflation	0.0177***	0.0155***	0.0196***	0.0146***	0.0188***	0.0193***	0.0178***	0.0149***	0.0173***	0.0158**	0.0175***
	(3.337)	(2.874)	(3.741)	(2.703)	(3.569)	(3.662)	(3.347)	(2.641)	(2.902)	(1.994)	(3.256)
Reserves	-0.0590***	-0.0580***	-0.0460**	-0.0699***	-0.0640***	-0.0625***	-0.0651***	-0.0872***	-0.0492**	-0.0722***	-0.0632***
	(-3.107)	(-3.053)	(-2.382)	(-3.576)	(-3.122)	(-3.023)	(-3.370)	(-4.052)	(-2.367)	(-3.621)	(-3.254)
Ka_open	-0.139**	-0.166***		-0.151***			-0.176***	-0.206***	-0.0479	-0.155***	-0.254***
	(-2.462)	(-2.903)		(-2.640)			(-3.053)	(-3.356)	(-0.768)	(-2.604)	(-4.179)
Politics	-0.0123	-0.0103	-0.0126	-0.00858	-0.0176**	-0.0150*	-0.0114	-0.00429	-0.0177*	-0.0101	-0.00463
	(-1.471)	(-1.223)	(-1.494)	(-1.007)	(-1.988)	(-1.712)	(-1.351)	(-0.466)	(-1.935)	(-1.149)	(-0.539)
Fiscal	0.00252	0.00156	0.00365	0.00280	0.00167	0.00107	0.00130	0.00274	-0.000374	-0.00386	0.00260
	(0.449)	(0.278)	(0.649)	(0.499)	(0.296)	(0.191)	(0.231)	(0.432)	(-0.0616)	(-0.475)	(0.458)
IT	1.374***	1.375***	1.535***	1.289***	0.680**	0.456	0.432	1.477***	1.224***	1.392***	0.382
	(7.503)	(7.528)	(7.222)	(6.930)	(2.378)	(1.416)	(1.440)	(7.174)	(6.065)	(6.754)	(1.549)
IT*Trade openness		0.0134***									
		(2.800)									
IT* Financial openness			0.0194***								
			(3.827)								
Financial openness			-0.0140***								
			(-2.907)								
IT* Financial_dvlpt				0.0175***							
				(3.701)							
IT*Bank foreign assets/total assets					-0.0331**						
					(-2.163)						
Bank foreign assets/total assets					-0.00709						
					(-1.478)						
IT*Bank foreign liabilities/total assets						-0.00846***					
						(-2.635)					
Bank foreign liabilities/total assets						-0.00275					
						(-0.488)					
IT*Inflation							-0.141***				
							(-3.898)				

IT* Net imports								-0.0971***			
								(-4.759)			
Net imports								-0.0349***			
								(-3.446)			
IT*External debt									-0.0193***		
									(-2.677)		
External debt									0.0153***		
									(4.443)		
IT*Pscore										2.179**	
										(2.368)	
Pscore										-1.775**	
										(-1.992)	
IT*Time											0.218***
											(5.796)
Observations	640	640	642	640	594	594	640	588	624	602	640
Number of id	36	36	36	36	35	35	36	36	36	35	36
Wald chi2 stat	88.33	95.72	89.58	97.43	78.09	78.72	100.5	117.5	96.31	90.27	113.4

Random effects probit model with panel data; constant included but not reported; all the control variables (except IT) are included with 1 year lag; the Wald chi2 test is a test for the null hypothesis that all the coefficients except the constant, are jointly equal to zero; ***, **, * indicate the statistical significance at 1%, 5% and 10% respectively.

V.2. Results from matching

Results of the probit model estimates are provided in appendix table V.6. The control variables are highly significant, except fiscal deficit. As expected, economic development and central bank independence are associated with higher probability of adopting the inflation targeting regime. The effect on the adoption of inflation targeting of trade openness, economic growth, lagged inflation, and foreign exchange reserves is negative. The effect of financial development seems to be mixed (associated coefficients are both positive and negative). The counter-intuitive negative effect of financial development holds when considering the sub-samples of targeters with higher external debt, lower financial openness, and lower financial development.

Prior to estimating the *ATT*, we ensure that the treated and control groups share the same support. In other words, we attempt to ensure that the estimated scores are comparable across treated and non-treated observations. To this end, we drop all treated units with scores higher than the maximum or lower than the minimum score for the non-treated units. Table V.4 presents the main results. From the baseline estimates of the *ATT* (the average effect of inflation targeting on the exchange rate regime), we find that *IT* has a positive and significant effect on exchange rate flexibility. This suggests that on average, the exchange rate regime is more flexible in inflation targeting emerging countries, compared to non-targeters, a result which echoes the baseline estimates obtained earlier.

As regards the estimated *ATT* conditional to the levels of z (the financial and macroeconomic conditions), the findings seem to be in line with conclusions derived from probit estimates.

The results suggest that inflation targeters with lower levels of external debt, lower levels of bank foreign assets to total assets ratio, and lower levels of bank foreign liabilities relative to total bank assets, float relatively more than the others. Indeed, the effect of *IT* on exchange rate flexibility is lower for those targeters whose external debt and the two ratios related to the banking system balance sheet exceed the defined threshold.[101] The latter finding supports our claim that emerging

[101] Conclusions are broadly in line with this finding when estimating the *ATT* conditional to the growth rates of bank foreign assets and bank foreign liabilities.

countries with less good external financial position (countries which are relatively more vulnerable to external financial shocks) are prone to more frequent foreign exchange interventions, and therefore less likely to operate in a freely floating exchange rate regime. As regards the impact of *IT* conditional to financial development, our finding with the PSM approach is mixed. There seems to be no significant difference in the *ATT* estimated for the two groups, based on the degree of financial development.

When estimating the *ATT* conditional to the level of inflation and net imports as a share of GDP, we find that targeters with better inflation performances (lower inflation rate) float relatively more than targeters with higher levels of inflation. The effect of *IT* on exchange rate flexibility is lower for targeters with higher inflation rate. Targeters which are less import-dependent (implying lower exchange rate pass-through) float relatively more than those whose net imports exceed the inflation targeting sample median. These results are also in line with our argumentation and the previous conclusion that, emerging countries' central banks with poorer inflation performances and which may be subject to stronger exchange rate pass-through to inflation, may be more inclined to control the exchange rate as means of policy adjustment.

Finally, the estimation of the effect of *IT* on exchange rate regime conditional to the degree of financial openness reveals that the more financially open inflation targeters float relatively more than those which are less integrated into the international financial system. The *ATT* is lower for the latter. Regarding the effect of *IT* conditional to the degree of trade openness, the results suggest that the exchange rate regime is less flexible for targeters which trade more with the rest of the world, compared to the others, a finding which contrasts our previous conclusion.

Overall, our findings with the PSM approach are broadly in line with conclusions from the probit baseline estimates. We find that the probability of adopting a flexible exchange rate regime is higher for inflation targeters. Moreover, among targeting emerging countries, the flexibility of the exchange rate does depend on specific financial and macroeconomic conditions.

Table V.4: Matching estimates

	Neighbor matching			Radius matching			Kernel matching
	Nearest neighbor	3 nearest neighbors	5 nearest neighbors	r=0.1	r=0.05	r=0.02	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Baseline	1.029***	0.935***	0.914***	0.902***	0.890***	0.911***	0.904***
	(6.244)	(7.108)	(7.255)	(11.62)	(8.966)	(8.082)	(8.232)
Obs.	617	617	617	617	617	617	617
		Total external debt (% GDP)					
Low	1.093***	1.167***	1.137***	1.098***	1.089***	1.179***	1.197***
	(4.776)	(5.970)	(6.391)	(10.00)	(8.839)	(8.158)	(8.117)
Obs.	535	535	535	535	535	535	535
High	0.984***	0.901***	0.837***	0.750***	0.818***	0.798***	0.802***
	(5.409)	(5.349)	(5.899)	(8.407)	(7.820)	(6.775)	(6.702)
Obs.	542	542	542	542	542	542	542
		Bank foreign assets/total assets					
Low	0.984***	0.962***	1.010***	1.000***	1.033***	1.030***	1.025***
	(5.088)	(6.037)	(6.968)	(13.81)	(11.90)	(9.400)	(8.510)
Obs.	540	540	540	540	540	540	540
High	0.922***	0.887***	0.821***	0.887***	0.862***	0.813***	0.810***
	(4.349)	(5.132)	(5.507)	(8.827)	(7.025)	(5.967)	(6.015)
Obs.	555	555	555	555	555	555	555
		Bank foreign assets/total assets					
Low	1.339***	1.242***	1.245***	1.115***	1.162***	1.244***	1.253***
	(6.813)	(7.284)	(8.500)	(16.74)	(12.70)	(10.16)	(10.53)
Obs.	540	540	540	540	540	540	540
High	0.792***	0.797***	0.829***	0.783***	0.797***	0.821***	0.825***
	(4.519)	(5.193)	(5.990)	(8.313)	(7.180)	(6.749)	(6.730)
Obs.	555	555	555	555	555	555	555
		Inflation rate					
Low	1.444***	1.278***	1.294***	1.081***	1.236***	1.276***	1.280***
	(6.502)	(7.692)	(8.949)	(8.435)	(9.573)	(10.35)	(9.921)
Obs.	514	514	514	514	514	514	514
High	0.910***	0.925***	0.946***	0.896***	0.858***	0.874***	0.868***
	(4.718)	(5.364)	(5.941)	(9.904)	(7.032)	(6.799)	(6.726)
Obs.	545	545	545	545	545	545	545

		Net imports (% GDP)					
Low	1.018***	1.117***	1.098***	0.973***	1.042***	1.062***	1.069***
	(4.909)	(6.873)	(7.765)	(12.21)	(11.57)	(9.319)	(9.299)
Obs.	535	535	535	535	535	535	535
High	0.734***	0.776***	0.759***	0.793***	0.763***	0.778***	0.772***
	(3.968)	(4.484)	(4.982)	(8.175)	(6.931)	(5.761)	(5.919)
Obs.	542	542	542	542	542	542	542
		Financial openness					
Low	0.915***	0.770***	0.772***	0.781***	0.798***	0.778***	0.781***
	(4.905)	(5.116)	(5.371)	(9.138)	(8.070)	(6.926)	(6.519)
Obs.	549	549	549	549	549	549	549
High	1.169***	1.164***	1.194***	1.116***	1.168***	1.175***	1.171***
	(5.698)	(6.583)	(7.518)	(11.85)	(9.623)	(9.035)	(8.922)
Obs.	546	546	546	546	546	546	546
		Trade openness					
Low	1.368***	1.245***	1.194***	1.142***	1.160***	1.169***	1.168***
	(6.852)	(7.657)	(7.862)	(11.97)	(10.69)	(9.118)	(9.130)
Obs.	547	547	547	547	547	547	547
High	0.957***	0.962***	0.920***	0.841***	0.906***	0.930***	0.930***
	(4.800)	(5.669)	(6.138)	(8.748)	(7.924)	(7.334)	(6.992)
Obs.	548	548	548	548	548	548	548
		Financial development					
Low	0.944***	0.907***	0.925***	0.878***	0.919***	0.965***	0.967***
	(5.369)	(6.311)	(7.183)	(10.95)	(9.080)	(8.706)	(8.579)
Obs.	550	550	550	550	550	550	550
High	0.741***	0.827***	0.889***	0.860***	0.916***	0.921***	0.911***
	(3.060)	(3.952)	(4.901)	(6.710)	(5.836)	(5.181)	(5.384)
Obs.	548	548	548	548	548	548	548

A 0.06 fixed bandwidth and an Epanechnikov kernel are used for kernel regression matching. T-statistics based on bootstrapped standard errors are reported in parentheses (500 replications). ***, **, and * indicate statistical significance at the 1, 5 and 10% levels, respectively. For the conditional variable considered, "Low" and "High" indicate that the targeters observations have been restricted to values lower and higher than the median respectively, the control group remaining unchanged.

VI. Robustness checks

To ensure the relevance of the results discussed above, we conduct a number of robustness checks. The first set of robustness tests relies on alternative specifications and estimation methods of equation (1). Next, we conduct a sensitivity analysis for the PSM estimates.

VI.1. Alternative specifications and estimation methods

First, the baseline model described in equation (1) is re-estimated using random effects ordered logit instead of the ordered probit. The results presented in table V.5 show that our main conclusions regarding the standard determinants of the exchange rate regime (not reported), as well as the effect of inflation targeting, remain broadly unchanged. The conditional effects related to the financial conditions and the macroeconomic environment also prove to be robust to this alternative estimation method.

Second, we control for some additional variables in order to better test the resilience of the previous estimates. In particular, we include dummy variables which capture currency crises, banking crises, and sovereign debt crises. While these dummies are found to have no effect on the exchange rate regime, the effects of the other variables remain in line with our main findings (appendix table V.4). We also control for the degree of central bank independence, a factor which may be jointly correlated with inflation targeting and the choice of exchange rate regime. The results suggest that the coefficient associated with the index of central bank independence is positive but not statistically significant, while our main results regarding the effects of inflation targeting on exchange rate regimes remain unchanged (appendix table V.5).

Table V.5: Random effects ordered logit estimates

	Dependent variable : de facto exchange rate regime										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
IT	2.532***	2.540***	1.535***	2.394***	1.223**	0.803	0.775	2.749***	2.223***	2.573***	0.642
	(7.435)	(7.466)	(7.222)	(6.948)	(2.345)	(1.376)	(1.435)	(7.115)	(5.846)	(6.735)	(1.426)
IT*Trade openness		0.0255***									
		(2.911)									
IT* Financial openness			0.0194***								
			(3.827)								
Financial openness			-0.0140***								
			(-2.907)								
IT* Financial_dvlpt				0.0399***							
				(4.374)							
IT*Bank foreign assets/total assets					-0.0617**						
					(-2.205)						
Bank foreign assets/total assets					-0.0108						
					(-1.326)						
IT*Bank foreign liabilities/total assets						-0.0157***					
						(-2.678)					
Bank foreign liabilities/total assets						-0.00644					
						(-0.653)					
IT*Inflation							-0.258***				
							(-3.943)				
IT* Net imports								-0.182***			
								(-4.845)			
Net imports								-0.0641***			
								(-3.379)			
IT*External debt									-0.0421***		
									(-3.202)		
External debt									0.0344***		
									(4.896)		
IT*Pscore										3.856**	
										(2.315)	
Pscore										-3.161*	
										(-1.935)	
IT*Time											0.407***
											(5.753)
Controls included ?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	640	640	642	640	594	594	640	588	624	602	640
Number of id	36	36	36	36	35	35	36	36	36	35	36
Wald chi2 stat	85.34	93.45	89.58	96.18	76.04	76.94	96.51	109.1	96.57	86.18	107.5

Random effects logit model with panel data; constant included but not reported; control variables (not reported) are the same as in table V.1; all the control variables (except IT) are included with 1 year lag; the Wald chi2 test is a test for the null hypothesis that all the coefficients except the constant, are jointly equal to zero; ***, **, * indicate the statistical significance at 1%, 5% and 10% respectively.

Table V.6: Robustness – Linear probability model

	Dependent variable : de facto exchange rate regime										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
IT	0.504***	0.529***	0.468***	0.457***	0.262*	0.160	0.0940	0.494***	0.378***	0.489***	0.148
	(6.105)	(6.419)	(5.754)	(5.464)	(1.931)	(1.043)	(0.726)	(6.069)	(4.591)	(5.208)	(1.402)
IT*Trade openness		0.00689***									
		(3.115)									
IT* Financial openness			0.00251**								
			(2.032)								
Financial openness			-0.000679								
			(-1.096)								
IT* Financial_dvlpt				0.00546***							
				(2.981)							
IT*Banks foreign assets/total assets					-0.0124*						
					(-1.782)						
Banks foreign assets/total assets					-0.00295						
					(-1.184)						
IT*Banks foreign liabilities/total assets						-0.00336**					
						(-2.259)					
Banks foreign liabilities/total assets						-0.00109					
						(-0.393)					
IT*Inflation							-0.0619***				
							(-4.079)				
IT* Net imports								-0.0361***			
								(-4.515)			
Net imports								-0.0152***			
								(-3.515)			
IT*External debt									-0.00861***		
									(-2.956)		
External debt									0.00781***		
									(5.664)		
IT*Pscore										0.984**	
										(2.335)	
Pscore										-0.907**	
										(-2.222)	
IT*Time											0.0764***
											(5.221)
Constant	0.860	0.761	1.007	0.601	2.010	2.193*	0.954	1.973*	-0.732	-0.921	1.711
	(0.727)	(0.648)	(0.849)	(0.510)	(1.532)	(1.672)	(0.817)	(1.728)	(-0.612)	(-0.725)	(1.464)
Controls included?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	640	640	642	640	594	594	640	588	624	602	640
R-squared	0.118	0.133	0.115	0.131	0.110	0.112	0.142	0.208	0.173	0.129	0.157
Number of id	36	36	36	36	35	35	36	36	36	35	36
F stat	7.976	8.239	7.019	8.155	6.179	6.274	8.954	12.91	10.01	6.854	10.05

OLS panel fixed effects estimates; controls are the same as in Table V.1, included with 1 year lag (except IT); robust T-stats in parentheses; ***, **, * indicate statistical significance at 1, 5 and 10% respectively; F test is the test for the null hypothesis that all the coefficients, except the constant, are jointly equal to zero.

Another important issue regarding the limited dependent variable approaches used so far is the relevance and interpretation of interaction effects in nonlinear models such as probit or logit. While many empirical studies rely on such analytical frameworks, others argue that the interaction effects produced by standard software may be misleading (see Ai and Norton, 2003). As an alternative approach, we used the linear probability model to investigate the conditional effects of inflation targeting on exchange rate regime.[102] Hence, we re-estimate the baseline equation (1) (the dependent variable being the cardinal de facto exchange rate regime variable) using OLS panel fixed effects. The results presented in table V.6 are in line with findings from nonlinear models. Inflation targeting has a positive and significant effect on exchange rate flexibility. Also, all the interaction terms exhibit strong significant effects, with expected signs.

Overall, the robustness checks produce reassuring results which show that the existence of non-linear effects that have been evidenced previously survived alternative estimators (probit, logit and linear probability models), various types of country-specific heterogeneity (fixed *versus* random effects), and a large range of additional control variables.

VI.2. Rosenbaum bounds

We also check the robustness of the results discussed above by testing the sensitivity of the matching estimates to unobserved heterogeneity. As stated in the model's description, the PSM procedure relies on the assumption that the treatment selection is based only on observable characteristics (the conditional independence hypothesis). Checking the sensitivity of the results with respect to deviations from this assumption is an important issue. Rosenbaum's (2002) approach determines if a hidden bias can emerge from the estimation of the average treatment effect, due to unobserved variables. This procedure is used to carry out the sensitivity analysis.

The Rosenbaum bounds test can be briefly described as follows. Let us assume that for an individual i, the probability of being treated is given by:

[102] Similar approaches have been used in the empirical literature dealing with interaction effects when the dependent variable is not continuous (see for example the paper from Martin et al., 2012 on trade agreements).

$$P_i = P(W_i, u_i) = P(T_i = 1 / W_i, u_i) = F(\beta W_i + \gamma u_i) \tag{3}$$

where W_i is the vector of the observed covariates, u_i is an unobserved covariate, β and γ are respectively the effects of W_i and u_i on the treatment selection, and F describes a logistic distribution.

The odds that two individuals *i* (treated) and *j* (non-treated) receive the treatment are given by $P_i/(1- P_i)$ and $P_j/(1- P_j)$, respectively, and the odds ratio is given by:

$$\frac{P_i / (1-P_i)}{P_j / (1-P_j)} = \frac{\exp(\beta W_i - \gamma u_i)}{\exp(\beta W_j - \gamma u_j)} \tag{4}$$

In the matching procedure, the observed characteristics are the same for all individuals, implying that

$$\frac{P_i / (1-P_i)}{P_j / (1-P_j)} = \exp\left[\gamma(u_i - u_j)\right] \tag{5}$$

The odds ratio will be equal to 1 if there is no effect of the unobserved variable on the treatment ($\gamma = 0$), or if the unobserved variable is the same for treated and non-treated ($u_i = u_j$). This indicates that there is no hidden bias. The sensitivity test then assesses the extent to which the treatment effect may be affected by changes in the values of γ and $u_i - u_j$. Rosenbaum shows that the relationship described by equation (4) implies the flowing bounds of the odds ratio:

$$\frac{1}{\Gamma} \leq \frac{P_i / (1-P_i)}{P_j / (1-P_j)} \leq \Gamma \tag{6}$$

where $\Gamma = \exp(\gamma)$. An odds ratio equal to 1 (Γ=1) suggests that there is no hidden bias. The Rosenbaum bounds analysis investigates the extent to which increasing values of Γ may imply increasing influence of unobserved variables. In particular, the smaller the lowest value of Γ producing a confidence interval that includes 0, the stronger the hidden bias.

The results suggest that our findings with the PSM are highly robust to potential hidden bias. Indeed, with values of Γ between 1 and 5, the confidence intervals do not include 0, implying that even if the unobserved characteristics increase the odds ratio by a factor of 5, there will be no significant effect of hidden bias (appendix table V.6). The average treatment effect of inflation targeting on the exchange rate regime estimated with various considerations discussed in section V.2 shows very little sensitivity to countries' unobserved characteristics.

VII. Conclusion

Controlling the exchange rate fluctuations is a crucial issue, particularly for emerging markets economies. The latter are on average more vulnerable to external shocks compared to developed countries, and therefore, are likely to be more affected by changes in exchange rate. Exchange rate fluctuations may originate from various sources related to international transactions, or arise from various types of external shocks. The resulting consequences can be critical for the emerging markets' financial and macroeconomic stability, given the structure of these economies characterized by higher dependence on external funding and imports of goods and services, low financial development, and poorer achievements in terms of macroeconomic stability. In this regard, policy strategies and interventions aiming to limit exchange rate fluctuations are not uncommon in emerging markets, even when they officially commit to a freely floating exchange rate regime.

The purpose of this chapter is to investigate the extent to which exchange rate interventions may be used as a prudential policy aiming to strengthen the stability of the financial sector, or as a means to preserve the financial sector from some sources of risk. It is argued that emerging markets with poorer financial conditions, or with a financial sector which is more exposed to external risks, may be more prone to attempt to control the exchange rate even if ex-ante, they have committed to a fully flexible exchange rate regime. We also investigate the role of macroeconomic conditions in determining foreign exchange interventions. Particularly, we argue that countries with poorer achievements in stabilizing the macroeconomic environment may be more likely to intervene on the foreign exchange market and rely on such interventions as a strategy to adjust their policy and ultimately improve their stabilization outcome.

To shed light on these issues, the sample of emerging markets inflation targeters offers an interesting baseline for our analysis. The exchange rate regimes prevailing in emerging countries which have adopted the inflation targeting strategy are on average more flexible than those of their non-targeting counterparts. More importantly, by implementing inflation targeting, those countries officially (at least in theory) commit to a freely floating exchange rate regime, since exchange rate interventions may impair the credibility and the effectiveness of the inflation targeting framework. Our study therefore proceeds as follows. First we estimate the effect of inflation targeting on the exchange rate flexibility and evidence a positive correlation between the adoption of this monetary policy strategy and the flexibility of the exchange rate regime. Next, we show that this positive effect can be affected by the financial and macroeconomic characteristics.

Precisely, results from the empirical investigation show that higher financial vulnerability to external shocks reduces the effect of inflation targeting on exchange rate flexibility. In other words, targeters whose financial sectors are more exposed to external risks intervene more frequently on the foreign exchange market for the purpose of safeguarding the stability of their financial system; a finding in line with our argumentation that foreign exchange interventions are used as an instrument to strengthen financial stability. We also show that stronger domestic financial development reinforces the positive effect of inflation targeting on the flexibility of the exchange rate regime. This suggests that financial development reduces the likelihood for foreign exchange interventions. A well-developed financial sector is likely to provide necessary instruments to financial institutions to mitigate potential risks. A strong financial development may also improve the ability of the financial sector to cope with an unexpected shock. As a result, for countries whose financial sectors are relative more developed, the need to control the exchange rate for financial stability purpose may be less relevant. Concerning the macroeconomic conditions, we find that targeters with poorer track records in meeting the inflation objective, and targeters which are more subject to the exchange rate pass-through to inflation, are more likely to rely on the control of the exchange rate to improve their performances. Finally, the degree of economic openness is found to reinforce the flexibility of the exchange rate regime, reducing foreign exchange interventions.

These results are robust. They are derived from panel data econometric estimates using limited dependent variable models (such as ordered logit and probit), and impact evaluation technics, such as matching on propensity scores. Various robustness tests (including linear probability models, the control for additional explanatory variables, and a sensitivity test for possible deviations from the conditional independence hypothesis, regarding the PSM estimates) have been conducted. Regardless of the technic which is used, the results remain qualitatively similar.

These results have widespread policy implications, beyond the issue of financial stability. First they show the heterogeneity of behavior among targeters. The financial conditions and macroeconomic environment are important, and understanding the exchange rate policy choices made by emerging market inflation targeters appears to be less straightforward than originally thought. While in some instances movements along the exchange rate policy spectrum can be justified or understood as stabilization mechanisms, for an inflation targeter, they also reflect a lack of credibility of the institutional arrangement in place and the failure of the traditional instruments used by the monetary authorities. Special attention should be paid to shifts in de facto exchange rate policies, especially when the financial and macroeconomic environment changes significantly. This could lead to important "disagreements" between the de jure exchange rate policy and the de facto exchange rate regime.

Second, the results also show that perhaps inflation targeting arrangements in emerging markets are not yet mature. This is supported by one of our results which shows that the positive association between inflation targeting and exchange rate flexibility increases in those countries with a higher propensity to adopt and maintain an inflation targeting regime, and decreases in inflation targeting countries which have difficulty in controlling inflation. This poses the fundamental question of what can be done to improve the marginal benefits of setting-up an inflation targeting regime ex-post. Which policy complementarities can/should be put in place to reduce the trade-off between conflicting objectives? Our findings show that financial development is one of such policies.

The main conclusions derived from this chapter highlight the tensions and challenges faced by modern central banks in emerging countries. With the increasing integration (trade and financial) of emerging markets into the global economy, the issue of the optimal architecture for monetary policy, taking into account spillovers from global partners, is at the forefront of the policy and academic debate. The challenges associated with globalization have led central banks in emerging markets to pursue a wide range of sensitive objectives on top of their inflation mandate. One of those issues is related to the extent to which concerns for financial stability should be taken into account in the monetary policy-making, given that financial openness may be associated with increasing exposure to external risks. This poses a critical question of whether financial stability should be an explicit objective of the central banks. The analyses conducted in chapters III and IV suggest that such a strategy in which the policy interest rate is used as an instrument to achieve financial stability does not seem to provide the expected outcome. The present chapter shows that an alternative instrument used in emerging markets is foreign exchange interventions. However, this poses a serious credibility problem in an inflation targeting regime, since this framework should be associated with a flexible exchange rate regime and a central bank which is focused on the main inflation stabilization objective.

Achievement regarding this objective of inflation stability is precisely another important challenge faced by central banks in inflation targeting emerging countries, especially in the context of increasing globalization of their economies. While in most cases, inflation has been reduced and stabilized at relatively lower levels than before (and compared to non-targeters), deviations from the official inflation target have been more recurrent compared to high income inflation targeters, leaving the credibility bias or time inconsistency problems intact. This chapter evidences that targeters with poorer performances in meeting their inflation target rely on foreign exchange interventions to try to improve their achievements. This may further accentuate the credibility problem that the adoption of inflation targeting regime tried to address in the first place.

These issues pose a crucial question which is whether exchange rate interventions enhance the effectiveness of inflation targeting (by contributing to insure financial stability and to improve the inflation stabilization performances) or deteriorate its effectiveness (by generating conflict of objectives and depressing the credibility of the framework). It can be argued that emerging markets inflation targeters may benefit from attempts to control the exchange rate fluctuations, at least in a first stage, at the beginning of the implementation of this monetary policy strategy (during a transition period). Indeed, this view is supported by some existing studies. For example, Garcia et al. (2011) show that financially vulnerable economies are more likely to benefit from the control of exchange rate because they are more likely to be adversely affected by demand shocks and they are more prone to risk premium shocks. Our findings are somehow in line with this intuition. We show that beyond the common inflation stabilization purpose, the attempt to control the exchange rate in emerging countries also seeks to improve financial stability, or to preserve the financial sector from potential (external) risks. Stone et al. (2009) also stress the important role of exchange rate in emerging market economies during the transition period toward a full-fledged targeting regime.

However, as stressed in a recent work by Castillo (2014) a coordination effort is needed during this transition period in the attempt to control both inflation and exchange rate, in order to avoid sending mixed signal to economic agents regarding the monetary policy stance. Moreover, this role of the exchange rate should be expected to be less relevant and foreign exchange interventions should be very limited or even disappear with increase in the maturity of the inflation targeting strategy. Both policies can hardly coexist in the long run, because a credible and effective inflation targeting framework requires that central bank remains focused on the inflation objective, with the short term interest rate being the main policy instrument, therefore implying full flexibility of the exchange rate regime.

The empirical framework used in this chapter may be subject to some limitations. One of those may be related to the general approach we use to assess the foreign exchange interventions. We rely on the de facto exchange rate regime, which captures various forms of attempts to control the exchange rate across countries and over time. However, such a variable does not allow capturing precisely and quantitatively the intensity of foreign exchange interventions. This approach is therefore rather qualitative. The choice to rely on such a framework is motivated by the fact that the de facto exchange rate regime classification entails a large set of information on countries' foreign exchange markets, not limited to changes in foreign exchange reserves or exchange rate volatility for example. Besides, reliable data on foreign exchange interventions per se are not available, especially for a large sample of countries as ours. Focusing on the prudential policy, and particularly prudential tools aiming to cope with external financial risks, cross country and time series data on relevant instruments such as capital controls or measures aiming to contain the risk of currency mismatch, are also not available. This makes it difficult to accurately assess their use in emerging countries. For our analytical framework, we rather rely on a broader approach which can encompass various forms of restrictions on the foreign exchange market.

Appendices

Appendix table V.1: De facto exchange rate regime classification

Codes	Regimes
1	• No separate legal tender
1	• Pre announced peg or currency board arrangement
1	• Pre announced horizontal band that is narrower than or equal to +/-2%
1	• De facto peg
2	• Pre announced crawling peg
2	• Pre announced crawling band that is narrower than or equal to +/-2%
2	• De factor crawling peg
2	• De facto crawling band that is narrower than or equal to +/-2%
3	• Pre announced crawling band that is wider than or equal to +/-2%
3	• De facto crawling band that is narrower than or equal to +/-5%
3	• Moving band that is narrower than or equal to +/-2% (*i.e.*, allows for both appreciation and depreciation over time)
3	• Managed floating
4	• Freely floating
5	• Freely falling
6	• Dual market in which parallel market data is missing

Course classification from Reinhart and Rogoff

Appendix table V.2: Sample

Inflation targeters	non-targeters	
Brazil (1999)	Algeria	Saudi Arabia
Chile (1999)	Argentina	Tunisia
Colombia (1999)	Bulgaria	Ukraine
Czech Republic (1997)	China	Venezuela, RB
Hungary (2001)	Ecuador	
Indonesia (2005)	Egypt, Arab Rep.	
Israel (1997)	Hong Kong SAR, China	
Korea, Rep. (2001)	India	
Mexico (2001)	Jordan	
Peru (2002)	Kenya	
Philippines (2002)	Kuwait	
Poland (1998)	Libya	
Romania (2005)	Malaysia	
South Africa (2000)	Morocco	
Thailand (2000)	Nigeria	
Turkey (2006)	Pakistan	

Inflation targeting adoption date in parentheses (Source: Roger, 2009)

Appendix table V.3: Data and sources

Variable	Description	Source
Exchange rate regime	De facto exchange rate regime classification available at: *http://www.carmenreinhart.com/data/browse-by-topic/topics/11/*	Reinhart and Rogoff
Trade openness	Imports + exports of goods and services in % of GDP	WDI , World Bank
Growth	Growth rate of GDP	WDI , World Bank
Economic_dvlpt	Log of real GDP per capita in constant U.S. dollar	WDI , World Bank
Financial_dvlpt	Domestic credit to private sector in % of GDP	WDI , World Bank
Inflation	Percentage change in consumer price index	WDI , World Bank
Reserves	Total reserves in months of imports	WDI , World Bank
Ka_open	Index of capital openness	Chinn and Ito (2008, updated 2011)
Politics	Index of political stability	ICRG
Fiscal	Change in government total debt	WEO, International Monetary Fund
Net imports	(Imports – exports of goods and services) in % GDP	WDI , World Bank
External debt	Total external debt in % of GDP	WEO, International Monetary Fund
Inverse of CBI	Five-year central bank governors turnover rate	Dreher et al. (2008)
Banks assets / liabilities	Banking institutions' assets / liabilities	IFS, International Monetary Fund
Financial openness	De facto index of financial openness = (external financial liabilities + assets) in % of GDP	Lane and Milesi-Ferretti (2007, updated 2011)

Appendix table V.4: Robustness – Random effects ordered probit estimates (controlling for crisis dummies)

	Dependent variable : de facto exchange rate regime										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
IT	1.380***	1.384***	1.556***	1.298***	0.695**	0.449	0.438	1.486***	1.230***	1.414***	0.375
	(7.513)	(7.549)	(7.260)	(6.951)	(2.419)	(1.382)	(1.458)	(7.176)	(6.084)	(6.841)	(1.514)
IT*Trade openness		0.0142***									
		(2.941)									
IT* Financial openness			0.0198***								
			(3.889)								
Financial openness			-0.0141***								
			(-2.919)								
IT* Financial_dvlpt				0.0183***							
				(3.820)							
IT*Banks foreign assets/total assets					-0.0334**						
					(-2.157)						
Banks foreign assets/total assets					-0.00711						
					(-1.480)						
IT*Banks foreign liabilities/total assets						-0.00877***					
						(-2.690)					
Banks foreign liabilities/total assets						-0.00317					
						(-0.558)					
IT*Inflation							-0.142***				
							(-3.894)				
IT* Net imports								-0.0984***			
								(-4.816)			
Net imports								-0.0352***			
								(-3.460)			
IT*External debt									-0.0193***		
									(-2.641)		
External debt									0.0150***		
									(4.330)		
IT*Pscore										2.226**	
										(2.415)	
Pscore										-1.937**	
										(-2.143)	
IT*Time											0.223***
											(5.828)
Controls included?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	640	640	642	640	594	594	640	588	624	602	640
Number of id	36	36	36	36	35	35	36	36	36	35	36
Wald chi2 stat	90.83	98.79	92.60	100.3	81.27	82.20	102.8	121.1	96.47	92.00	115.6

Random effects probit model with panel data; constant included but not reported; the control variables (not repoted) are the same as in Table V.1, in addition to Banking crisis, Currency crisis, and Sovereign debt crisis dummies; all the controls (except IT) are included with 1 year lag; the Wald chi2 test is a test for the null hypothesis that all the coefficients except the constant, are jointly equal to zero; ***, **, * indicate the statistical significance at 1, 5 and 10% respectively.

Appendix table V.5: Robustness – Random effects ordered probit estimates (controlling for central bank independence)

	Dependent variable : de facto exchange rate regime										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
IT	1.390***	1.388***	1.536***	1.309***	0.674**	0.465	0.453	1.502***	1.239***	1.391***	0.396
	(7.587)	(7.597)	(7.229)	(7.035)	(2.356)	(1.443)	(1.509)	(7.305)	(6.162)	(6.683)	(1.609)
IT*Trade openness		0.0128***									
		(2.694)									
IT* Financial openness			0.0189***								
			(3.738)								
Financial openness			-0.0136***								
			(-2.839)								
IT* Financial_dvlpt				0.0177***							
				(3.687)							
IT*Banks foreign assets/total assets					-0.0349**						
					(-2.265)						
Banks foreign assets/total assets					-0.00712						
					(-1.470)						
IT*Banks foreign liabilities/total assets						-0.00863***					
						(-2.683)					
Banks foreign liabilities/total assets						-0.00231					
						(-0.405)					
IT*Inflation							-0.140***				
							(-3.872)				
IT* Net imports								-0.0977***			
								(-4.792)			
Net imports								-0.0334***			
								(-3.287)			
IT*External debt									-0.0193***		
									(-2.677)		
External debt									0.0148***		
									(4.306)		
IT*Pscore										2.175**	
										(2.356)	
Pscore										-1.751*	
										(-1.791)	
IT*Time											0.218***
											(5.822)
Controls included?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	628	628	630	628	583	583	628	576	614	602	628
Number of id	35	35	35	35	34	34	35	35	35	35	35
Wald chi2 stat	89.16	95.97	89.73	97.86	78.72	79.00	101.2	118.1	96.37	90.24	114.7

Random effects logit model with panel data; constant included but not reported; control variables (not reported) are the same as in Table V.1 in addition to a proxy for central bank independence, all the control variables (except IT) are included with 1 year lag; the Wald chi2 test is a test for the null hypothesis that all the coefficients except the constant, are jointly equal to zero; ***, **, * indicate the statistical significance at 1, 5 and 10% respectively.

Appendix table V.6: Probit model of the matching estimates

		External debt		Banks foreign assets/total assets		Banks foreign liabilities/total assets		Inflation		Net imports		Financial openness		Trade openness		Financial development	
	Baseline	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Trade openness	-0.0065***	-0.0095***	-0.0021	-0.0153***	-0.00307*	-0.0122***	-0.0033**	-0.005***	-0.0066***	-0.0069***	-0.005***	-0.009***	-0.006***	-0.038***	-0.0012	-0.0014	-0.0087***
	(-4.172)	(-4.455)	(-1.118)	(-4.501)	(-1.942)	(-4.300)	(-2.022)	(-2.902)	(-3.523)	(-3.640)	(-2.898)	(-2.958)	(-3.640)	(-6.600)	(-0.756)	(-0.470)	(-4.881)
Growth	-0.0385**	-0.0292	-0.0401*	-0.0108	-0.0569***	-0.0242	-0.0461**	-0.0188	-0.0456**	-0.0494**	-0.0222	-0.0199	-0.0454*	-0.0477*	-0.0214	0.00566	-0.0666***
	(-2.034)	(-1.251)	(-1.819)	(-0.448)	(-2.595)	(-0.977)	(-2.188)	(-0.763)	(-2.174)	(-2.193)	(-0.980)	(-0.888)	(-1.902)	(-1.920)	(-0.903)	(0.244)	(-2.618)
Economic_dvlpt	0.479***	0.401***	0.476***	0.412***	0.453***	0.365***	0.485***	0.457***	0.414***	0.360***	0.497***	0.375***	0.608***	0.576***	0.438***	0.397***	0.663***
	(7.463)	(4.936)	(6.335)	(5.100)	(6.006)	(4.530)	(6.470)	(5.356)	(5.702)	(4.666)	(6.327)	(5.161)	(6.293)	(5.944)	(5.600)	(5.111)	(6.127)
Financial_dvlpt	0.00203	0.00840***	-0.00662**	0.00423	0.00261	0.00678***	-0.000260	0.00555**	0.000769	0.00809***	-0.00218	-0.0066**	0.0107***	0.00398	0.00280	-0.0351***	0.0191***
	(1.033)	(3.714)	(-2.120)	(1.564)	(1.143)	(2.614)	(-0.109)	(2.134)	(0.329)	(3.284)	(-0.873)	(-2.156)	(4.426)	(1.532)	(1.112)	(-5.683)	(6.805)
Lag_Inflation	-0.0597***	-0.0521***	-0.0540***	-0.0586***	-0.0496***	-0.0618***	-0.047***	-0.086***	-0.0423***	-0.0580***	-0.048***	-0.048***	-0.0743***	-0.051***	-0.0721***	-0.0597***	-0.0709***
	(-5.130)	(-3.358)	(-4.256)	(-3.921)	(-3.628)	(-3.811)	(-3.791)	(-4.026)	(-3.828)	(-3.679)	(-3.870)	(-4.244)	(-3.579)	(-3.960)	(-3.881)	(-5.160)	(-3.024)
Reserves	-0.0377**	-0.0294	-0.0369*	-0.0179	-0.0538**	-0.0303	-0.0364*	-0.0164	-0.0525**	-0.0137	-0.0596**	-0.0271	-0.0430*	-0.0178	-0.0623**	-0.0500***	-0.0308
	(-2.295)	(-1.478)	(-1.907)	(-0.983)	(-2.296)	(-1.503)	(-1.857)	(-0.844)	(-2.461)	(-0.767)	(-2.454)	(-1.528)	(-1.778)	(-0.902)	(-2.302)	(-2.609)	(-1.180)
Fiscal deficit	0.00121	-0.00232	0.00318	0.000295	-0.00161	-0.00653	0.00397	0.00438	-0.00194	-0.0117	0.0101	0.00381	-0.000673	-0.0131	0.00362	0.00501	-0.00219
	(0.148)	(-0.207)	(0.367)	(0.0283)	(-0.170)	(-0.572)	(0.447)	(0.440)	(-0.213)	(-1.059)	(1.120)	(0.431)	(-0.0624)	(-1.037)	(0.374)	(0.602)	(-0.175)
Inverse of CBI	-0.907**	-1.268**	-0.472	-0.939**	-0.738	-0.901*	-0.743	-0.217	-1.159***	-0.417	-1.183**	-1.115**	-0.405	-1.595***	-0.344	-0.980**	-0.619
	(-2.339)	(-2.426)	(-1.085)	(-2.030)	(-1.549)	(-1.867)	(-1.640)	(-0.422)	(-2.655)	(-0.891)	(-2.499)	(-2.527)	(-0.752)	(-3.262)	(-0.682)	(-2.221)	(-1.014)
Constant	-3.387***	-3.392***	-3.735***	-3.045***	-3.782***	-2.851***	-3.992***	-4.223***	-3.016***	-3.323***	-3.738***	-2.466***	-5.542***	-2.918***	-3.949***	-2.080***	-6.464***
	(-5.936)	(-4.612)	(-5.662)	(-4.269)	(-5.527)	(-3.910)	(-5.979)	(-5.304)	(-4.732)	(-4.747)	(-5.378)	(-3.917)	(-6.036)	(-3.810)	(-5.410)	(-3.173)	(-6.118)
Observations	691	618	624	614	628	613	629	607	635	619	623	623	619	621	621	624	618
Pseudo R2	0.240	0.242	0.224	0.225	0.243	0.219	0.233	0.267	0.201	0.226	0.231	0.195	0.336	0.325	0.266	0.281	0.432

T-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1, 5 and 10% levels, respectively. For the conditional variables considered, “Low” and “High” indicate that the targeters observations have been restricted to values lower and higher than the median, respectively.

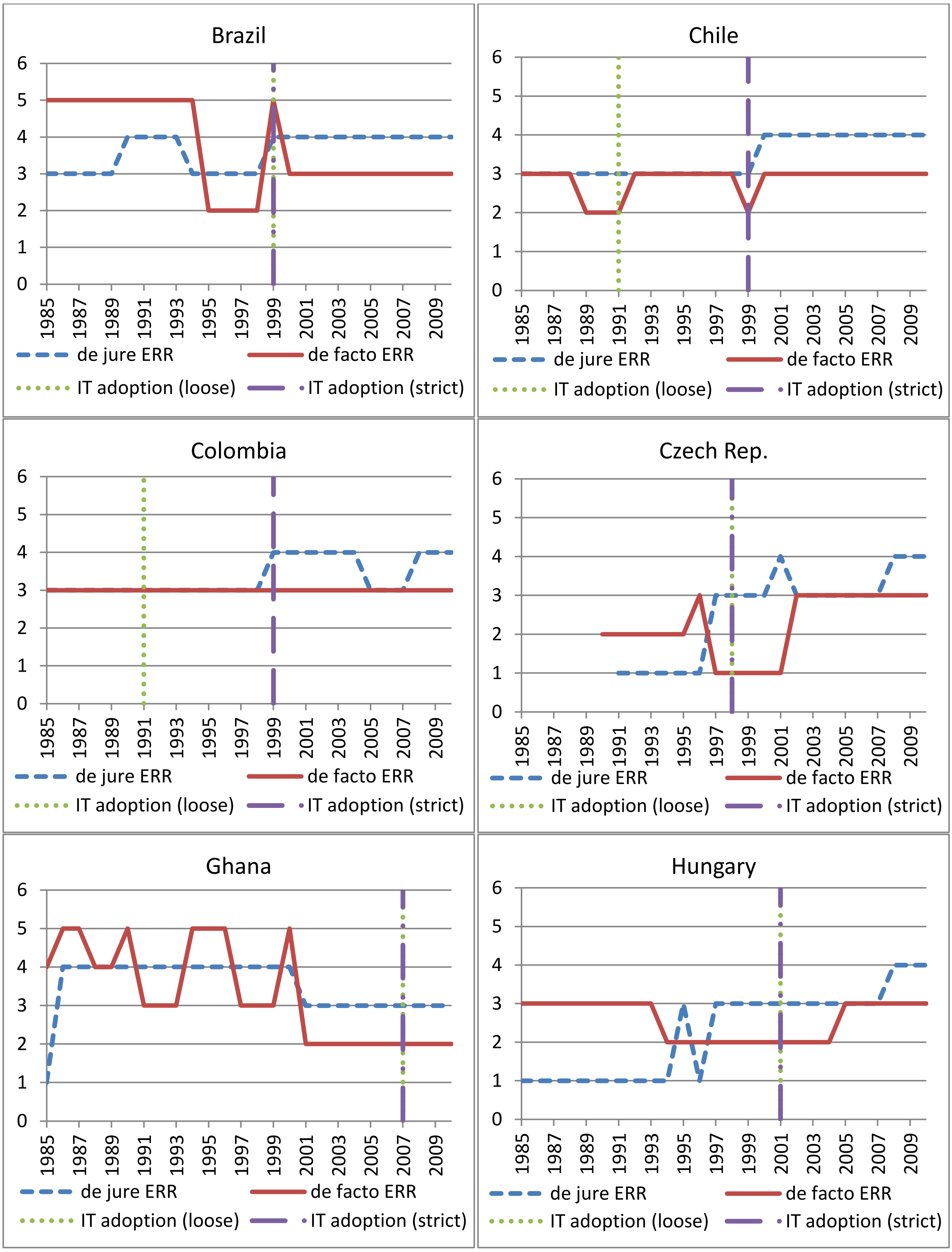
Appendix table V.7: Sensitivity analysis (Rosenbaum bounds test)

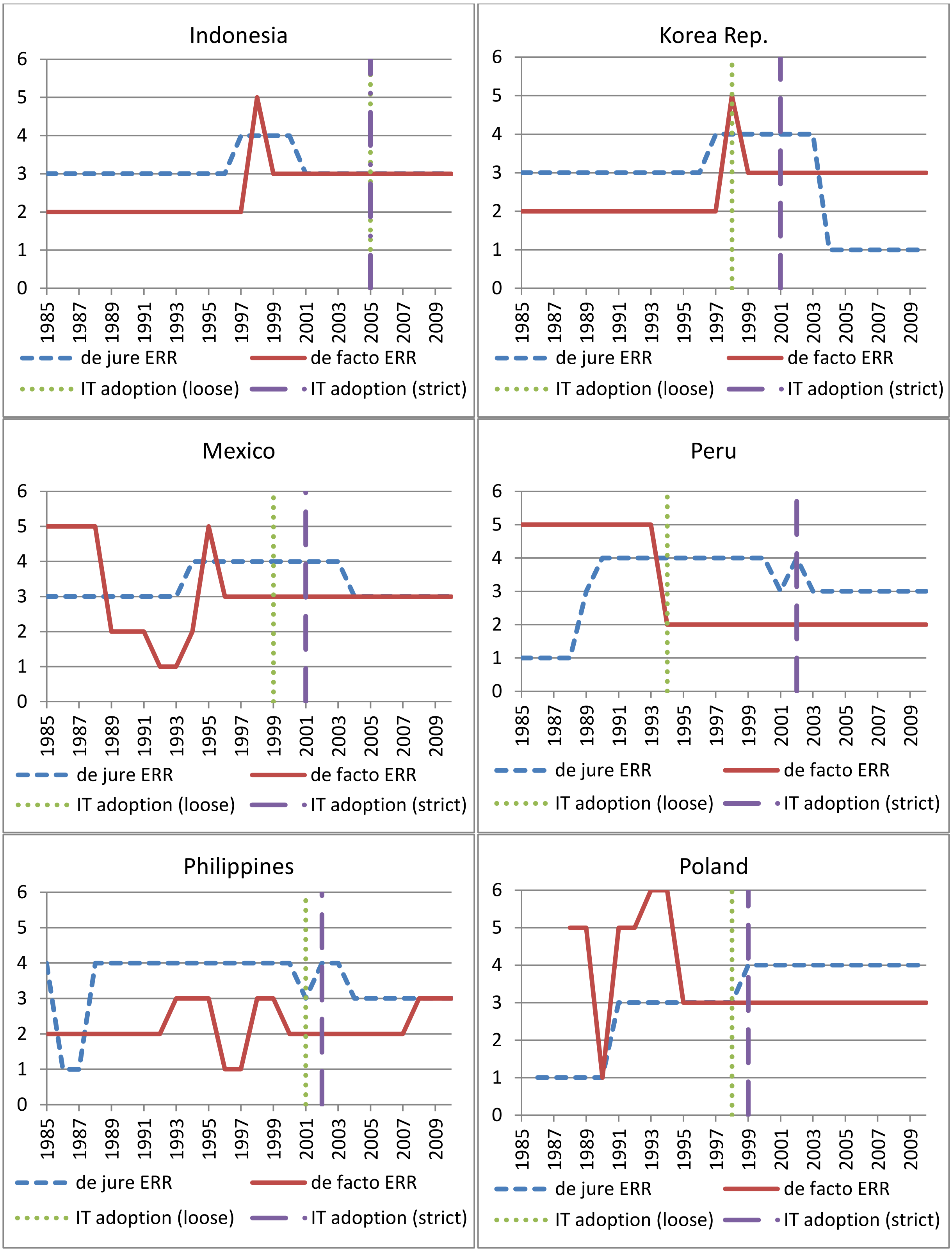
		Γ	significance level		Hodges-Lehmann point estimate		95% confidence interval	
			upper bound	lower bound	Min	Max	Min	Max
Baseline								
		1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	3
		5	0	0	1.5	3	1.5	3
External debt								
	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	3
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
Bank foreign assets/total assets	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	3
Bank foreign liabilities/total assets	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
Inflation								
	Low	1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
	High	1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5

		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	3
Net imports								
	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
Financial openness	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	3
Trade openness	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	2	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	3
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
Financial dvlpt	Low							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	2.5
	High							
		1	0	0	2	2	2	2
		2	0	0	2	2.5	1.5	2.5
		3	0	0	1.5	2.5	1.5	2.5
		4	0	0	1.5	2.5	1.5	2.5
		5	0	0	1.5	2.5	1.5	3

The test is conducted for the nearest neighbor matching estimated. The STATA command "rbounds" is used to perform this sensitivity test. Note that this command is more suitable for continue dependent variable (to the best of our knowledge, a command for ordered limited variables does not exist).

Appendix figure V.1: Evolution of the exchange rate regime in emerging markets inflation targeters




Indonesia
Korea Rep.
Mexico
Peru
Philippines
Poland
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1
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3
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5
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1985
1987
1989
1991
1993
1995
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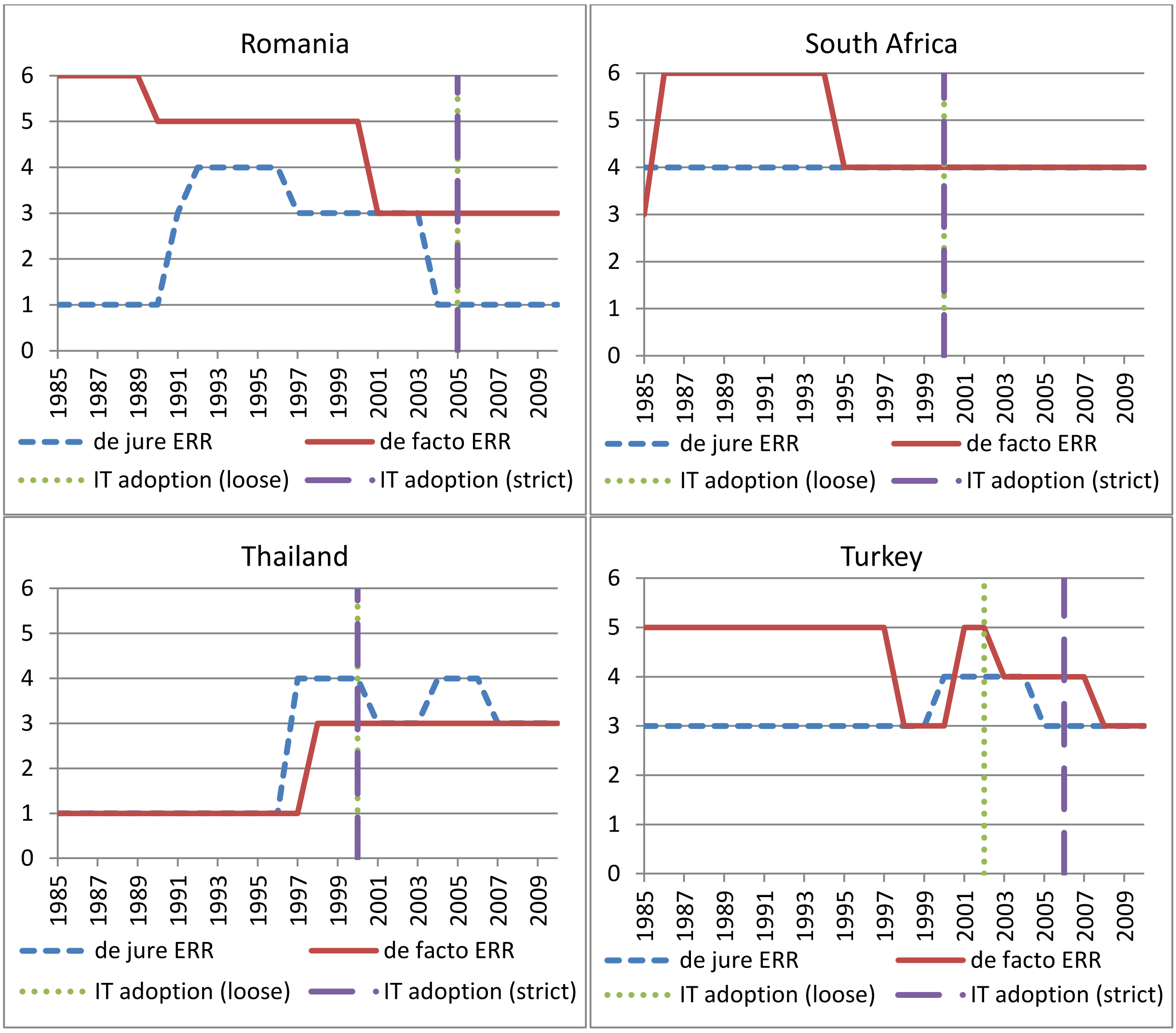
2001
2003
2005
2007
2009
de jure ERR
de facto ERR
IT adoption (loose)
IT adoption (strict)



De facto exchange rate regime data from Reinhart and Rogoff classification; de jure regime data from the IMF classification; "loose" inflation targeting adoption date from Samarina et al. (2013) and strict date from Roger (2009).

General Conclusion

The two decades preceding the 2008/2009 global financial crisis have been characterized by an increasing focus on inflation stabilization in the monetary policy-making. Central banks have been assigned the main mandate of inflation stability, generally with a precise numerical inflation target or target range. This policy framework has succeeded in significantly reducing and maintaining both low levels of inflation rate and inflation volatility, in developed countries but also among emerging markets economies. A conventional wisdom prevailing in this policy framework was that achieving inflation and macroeconomic stability, also, to some extent, guarantees financial stability. Financial imbalances are assumed to show up into aggregate price, and therefore, by controlling the changes in aggregate price, the monetary authorities also (although indirectly) strengthen the financial sector stability. The recent global financial crisis has considerably challenged this view. The crisis emerged while the global economy was navigating in very calm seas, characterized by low and stable inflation rates.

The global financial crisis has first affected the financial sectors in the U.S. and the most developed and financially integrated advanced economies, and subsequently spread to emerging markets. Performances in residential mortgage credit markets significantly deteriorated, with a sharp fall in house prices. Commercial and real estate prices also significantly dropped during the crisis, compared to pre-crisis peaks. Higher volatility and increasing uncertainty exacerbated the perceived risk in financial markets. The banking sector and credit supply have been particularly affected during this period, constraining the financing conditions. Those impairments in the financial environment translated to the real economic activity, generating significant macroeconomic instability and huge macroeconomic imbalances. Restrictions in credit provision coupled with an increasingly unstable economic environment, led to a sharp slump in investment. As a consequence, unemployment sharply increased in advanced and emerging markets economies as well. The aggregate consumption dropped, and ultimately, the output growth significantly fell, attaining negative rates in many industrialized economy and remaining very low until recently.

Concerning the causes of the crisis, on the one hand, weaknesses regarding the control of financial innovations and the ineffectiveness of the existing financial regulation framework prevailing in the early 2000s are considered to be the main source of the increase in financial risks which culminated into a global financial turmoil in 2008/2009. On the other hand, the monetary policy-making which has prevailed during the pre-crisis period has been criticized and pointed as another source of the recent global financial crisis. The low and stable inflation rate during the pre-crisis period has been accompanied by an accommodative monetary policy (especially in the U.S.) and increasing liquidity. This, in turn, might have encouraged credit demand since at the same time risk premium and interest rates were decreasing. The work conducted in this Ph.D thesis especially focuses on this later link between monetary policy and financial risks.

Issues investigated

Broadly speaking, our purpose is to investigate the extent to which financial stability concerns are more likely to prevail in a framework where the monetary authorities are focused on an inflation stability objective. Following vehement criticisms addressed against the inflation targeting regime in the wake of the recent crisis, this issue is among the key discussions in the monetary policy-making. We further assess some policy responses which are actually implemented, or which could be implemented to address those financial risks, in an inflation-stability-based monetary policy-making. Those responses include central bank's interventions through the policy interest rate, foreign exchange interventions, but also macroprudential measures. Each chapter of this dissertation investigates more specific issues, as detailed bellow.

The first chapter provides in a broad assay, a discussion on the nexus between monetary policy, the macroprudential framework, and financial stability. First, it reviews the conventional wisdom which guided the conduct of monetary policy for decades before the recent global financial shock. It is argued that during this period, the monetary policy-making was mainly oriented toward stabilizing the aggregate price level. In such a framework, the monetary authorities were not particularly concerned with financial stability issues. The global financial crisis has questioned this view, stressing strong interconnections between the monetary policy stance and developments of financial risks. Therefore, the chapter next assesses the extent to which monetary policy can promote financial instability, or rather contribute to dampen financial risks. Indeed, various channels, discussed in the literature suggest that loosen monetary policy conditions can be associated with higher financial instability.

While central banks have recently been asked to be more cautious about developments in the financial sector, and even expand their policy mandate to respond to financial risks, this strategy is likely to be ineffective. As suggested in this chapter, the leaning against the wind approach may bear some limitations. First, it can generate trade-offs between the central banks' objectives. Second, the short term interest rate is certainly too blunt an instrument to be effective in targeting specific risks. Third, such a reaction can be counterproductive and generate higher financial instability. Finally, raising the policy interest rate in response to financial imbalances can be costly in terms of output losses. Given those drawbacks, macroprudential policy is discussed as a more appropriated framework to address the risks in the financial sector. Macroprudential policy aims at dealing with the system-wide risk, and relies on a large set of tools which can be targeted to specific sources of risk. Therefore, the prudential framework can be expected to be more effective in safeguarding the financial sector stability.

Following the criticisms against the inflation targeting regime in the aftermath of the crisis, we investigate how those inflation targeting countries performed during the global financial shock, compared to others. This issue is investigated in chapter II. The starting point of our argumentation in this analysis is based on the existing literature on the macroeconomic performances of inflation targeting, and the literature on the determinants of countries' resilience to the crisis. Conclusions derived from those two strands of the literature seem to suggest that targeters can be expected to perform better in coping with the crisis, thanks to stronger initial macroeconomic conditions (including better fiscal and external positions, lower debt and lower exchange rate volatility), but also thanks to higher central bank credibility and higher initial policy rates which provides more room for monetary policy easing when needed. First, targeters and non-targeters are confronted in terms of central banks achievements in mitigating deflationary risks, in avoiding sharp increases in inflation volatility and real interest rates, and in lowering their policy rates to accommodate the shock. Second, the two groups are confronted in terms of more general economic performances regarding the output losses during the crisis.

In the third chapter, we investigate more closely the extent to which adopting and implementing the inflation targeting monetary policy strategy can generate higher financial fragility. It has been argued that this policy strategy is likely to be associated with stronger financial instability risks, especially because inflation targeting central banks are too focused on their aggregate price stability objective and much less concerned with imbalances in the financial sector. By looking narrowly at the targeting central banks' reaction functions, we shed light in this issue. Those analyses however require a definition and a measurement of financial instability, which remain a tricky issue in the existing literature. Beyond the common credit-related indicators of financial risk, this chapter proposes a composite index which captures the financial conditions through a large set of macro-financial variables. It also proceeds with an assessment of those financial conditions in various regional groups of emerging markets economies, comparing targeting and non-targeting countries.

The last two chapter of the dissertation explore existing and potential policy responses to financial risks, in a framework where aggregate price stability remains the main central bank's objective.

One of the main issues discussed in current debates on the monetary policy-making is whether central banks should lean against financial imbalances. It is argued that such a monetary policy response can be effective in containing financial risks and significantly contribute to preserve the financial sector stability. However, some other arguments stress that this framework can generate trade-offs between the standard macroeconomic stability objective of monetary policy, and the additional financial stability goal. The fourth chapter of this dissertation investigates the effectiveness of this leaning against the wind approach, and the extent to which the policy objectives can be conflicting in such a framework. It further introduces a macroprudential instrument (aiming to address the concern for financial instability) and explores how this new (extended) policy framework performs in terms macroeconomic and financial stability. Various possible policy strategies to cope with financial shocks, including diverse combinations of the central bank's and the prudential authority's responses, are assessed.

In emerging market economies, given their higher vulnerability to external shocks, exchange rate fluctuations and their potential impact for the financial sector stability is a matter of particular concern. Our work also looks at this issue more closely. Especially, in the fifth chapter we explore the extent to which the control of exchange rate might be used as a prudential tool in emerging market inflation targeters, to address their financial vulnerability to external shocks. This may suggest that those targeting central banks are likely to deviate from their initial commitment to a freely floating exchange rate regime (which accompanied the adoption of inflation targeting), when their financial conditions deteriorate, or when external financial vulnerabilities increase. This issue of the vulnerability of emerging markets to external shocks has been revived recently, with important surges in capital flows to those economies in the wake of the global financial crisis. The ongoing monetary policy normalization in the U.S. has further stressed this concern.

For the purpose of investigating all the above mentioned issues, our work relies on statistical, empirical (estimations), as well as theoretical methods. The statistical tools include basic graphical analyses, but also principal component analysis and a clustering approach. The principal component analysis, a standard approach for data aggregation, is used to construct our composite index of financial instability. We rely on a cluster analysis (based on dendrograms) to evidence some financial and macroeconomic heterogeneities and dissimilarities among emerging countries inflation targeters, before and after the adoption of this monetary policy regime. Regarding the estimation methods, they include the two-stage generalized method of moment estimates, which is used to overcome the suspected endogeneity bias. We use event studies and impact evaluation methods such as the difference in difference, and a variety of propensity score matching estimates. The latter estimation technic is very useful to address the self-selection bias surrounding the adoption of inflation targeting in our empirical investigations. Limited dependent variables technics such ordered probit and ordered logit models are also implemented in our empirical analyses. Finally, regarding the theoretical approach, our starting point is the standard three-equation new Keynesian model. This model is complemented with a banking sector and an endogenous asset price bubble. This allows assessing the interconnection between the macroeconomic environment and the financial sector, but also the effect of various policy responses (including monetary and macroprudential policies) to financial shocks.

Main findings

The main analyses conducted in this work have provided some interesting conclusions.

When assessing the performances of the inflation targeting regime during the 2008/2009 global financial crisis, we evidence that targeting central banks did better than the others in mitigating the consequences of the shock. Especially, inflation targeting countries have been significantly less affected by the increase in real interest rate, the rise in inflation volatility, and deflationary risks. However, this relative good central banks resilience to the shock does seem to have translated to the real economic activity. Indeed, when assessing the comparative performances in terms of decline in GDP growth, our findings suggest that despite stronger initial macroeconomic conditions, there is no significant difference between the two groups during the crisis. Among possible explanations for the latter conclusion, it is argued that countries implementing the inflation targeting regime could have entered the crisis with more fragile financial sectors (in line with criticisms against this policy strategy, in the aftermath of the crisis). The assessment of the financial conditions in emerging market targeting versus non-targeting countries support this view.

Based on both various simple and standard indicators of financial instability as well as our constructed composite index of financial fragility, we find that financial sectors in targeting countries are relatively more unstable than those of non-targeters. This raised the issue of whether this higher financial instability in targeting countries is due to the fact that monetary authorities are less responsive to increasing financial imbalances. We shed light on that issue by looking at the central banks' reaction functions, and the extent to which monetary policy is concerned with financial instability risks, when setting the policy interest rate. The results suggest that central banks implementing the inflation targeting also respond to financial risks through the short term interest rate. Those central banks therefore seem to follow a flexible inflation targeting regime in which the policy instrument is also set in response to financial disequilibrium. This response however, in some cases, depends on their achievements regarding the inflation objective. Especially, some central banks appear to be particularly concerned with financial imbalances only when their inflation objective is achieved.

However, such a leaning against the wind strategy has been questioned in recent debates, because it can generate trade-offs between the policy objectives. We theoretically investigate this issue and conclude that if the monetary authority is directly concerned with financial stability risks when setting its policy interest rate, a trade-off emerges between the standard macroeconomic stability objective and the additional financial stability goal. As argued in very topical and growing discussions, the macroprudential framework is likely to be more effective to address financial risks. Our analysis reaches conclusions in line with this literature. Indeed, we find that including a prudential tool devoted to tackle financial instability provides a stronger and more desirable policy outcome. Furthermore, regarding the prudential instrument, the results suggest that a tool which adjusts automatically with the perceived level of risk (a countercyclical tool) performs better in stabilizing the financial sector. In addition, despite the implementation of a prudential policy, we evidence that monetary authorities can significantly contribute to improve the overall macroeconomic and financial stability outcome, by being more cautious about developments in the financial sector and their effects on the real economic activity. This role of the central bank is likely to depend on the nature and the source of risk. In this respect, we argue that emerging market economies are likely to be particularly concerned with the exchange rate fluctuations, leading to some attempts to intervene on the foreign exchange market.

We show that in emerging market inflation targeters, central banks take actions to control the exchange rate in order to preserve the domestic financial sector from external risks. In other words, foreign exchange interventions are used as a prudential tool in emerging economies to mitigate their vulnerability to external shocks. Our findings also suggest that macroeconomic conditions such as higher trade and financial openness, and exchange rate pass through to inflation, affect the likelihood of foreign exchange interventions in countries implementing the inflation targeting regime. Furthermore, we evidence that targeters with poorer track records in achieving the inflation stability objective are more likely to undertake foreign exchange interventions to improve their stabilization outcome. These results underline a strong fact. They suggest that emerging countries which have adopted the inflation targeting regime tend to deviate significantly from their initial commitment to a freely floating exchange rate regime, when external financial vulnerabilities become a matter of concern.

Policy implications

Straightforward and powerful policy implications can be derived from the above discussed results of investigations conducted in this dissertation.

The relatively good performances of the inflation targeting regime during the recent financial crisis stress the role and the importance of monetary policy credibility in crisis periods. As discussed in the second chapter, the adoption of this monetary policy strategy has been found to be associated with higher central banks' credibility. Given the increasing uncertainties and markets failures which generally characterized a financial turmoil, the extent to which monetary authorities' communication and interventions can be effective in mitigating those effects, depends particularly on whether these policy actions are perceived as reliable by the private sector. Therefore, building a strong reputation in normal time should remain among the key objectives in the central banking. This role of policy credibility has been further underlined during the crisis resolution, and especially during the implementation of unconventional monetary policies in advanced economies (including the U.S., the U.K. and Japan).

A related issue, in crisis periods, is the role of the initial macroeconomic conditions. We show that when entering a financial crisis, good initial macroeconomic conditions (sound fiscal and external positions, low level of debt) can be critical to mitigate the impact of the shock. Strengthening the fiscal position (avoiding excessive fiscal deficits, or building buffer to generate some fiscal space) and being cautious about external imbalances should therefore remain at the forefront of the policy objectives in normal time. Fiscal policy plays a crucial role in crisis period, and may be determinant when addressing the consequences of a crisis. Available fiscal space allows automatic stabilizers to be fully operational, but also offers the opportunity to run fiscal stimulus and provide support to the most affected sectors in the economy. On the contrary, an initially unsustainable fiscal position is likely to worsen the negative effects of the crisis because the required fiscal consolidation will further depress the economic activity, but also because of the existing adverse feedback loops between sovereign and financial risks.

Our conclusion that despites central banks response to financial imbalances, emerging market inflation targeters are more financially vulnerable than their non-targeting counterparts is instructive in at least two points. First, it questions the effectiveness of the leaning against the wind strategy, and second, it underlines the fact targeting countries cannot be qualified as "inflation nutters". Regarding the latter point, we argue that reasons for higher financial fragility in targeting countries are other than central banks' unconcern with financial stability. Especially, given their higher integration into the global financial system, external vulnerabilities are certainly more pronounced. This first intuition has been supported by our finding that these countries rely on foreign exchange interventions to address those external risks. However, we claim that the attempt to control the exchange rate is likely to be incompatible with a full-fledged inflation targeting regime. Consequently, those countries should rather seek to implement or strengthen their macroprudential framework, especially aiming to mitigate external financial risks. In this respect, prudential tools targeted to regulate banks and corporates external financing (or foreign exchange exposure) are required (see chapter I). Capital controls or capital flows measures can also be implemented if necessary, but their use should be more limited to avoid the related potential costs.[103] The financial sector deepening, characterized by a great ability to manage capital flows and to provide hedging instruments against foreign exchange exposure, is also a prerequisite to improve the resilience to external shocks.

Regarding the effectiveness of the leaning against the wind, we show that this strategy generates trade-offs between the monetary authorities' objectives. This suggests that central banks cannot rely on a single policy instruments (the short term interest rate) to achieve both financial and macroeconomic stability. Rather, an operational and effective macroprudential framework should be implemented to tackle the financial risks. As argued in the first chapter, macroprudential policies rely on a large set of instruments which can be affected to various specific sources of risk. Furthermore, we show that the setting of the prudential instrument

[103] Capital flow measures can generate costs by reducing the financial market discipline, by tightening the financing constraints and restricting access to foreign capital, or by limiting the portfolio diversification. Therefore, to be effective, those measures should be transparent, temporary and non-discriminatory.

matters (countercyclical versus fixed capital requirements). This emphasizes the importance of the choice of the appropriate tool, since it will determine the policy success in terms of stabilization. Prudential authorities should therefore be cautious in this regard and make sure to learn lessons from previous experiences in order to fill gaps where necessary (since macroprudential policies are relatively new in practice).

Our analysis has also emphasized that despite the existence and the implementation of a macroprudential policy, the monetary authority can significantly contribute to enhance the stability of the overall economic environment when a financial shock occurs. In line with our discussion in the first chapter, this suggests that the regulatory and the monetary authorities should work hand-in-hand and coordinate their actions in order to achieve the best stabilization outcome. Coordination between those two policies is needed because they interfere with each other. Each policy can impair the effectiveness of the other, or rather contribute to improve its achievements. This issue is now among the key discussions in prudential and monetary policy-making.

Overall, this Ph.D. dissertation provides some insights with respect to two main questions which emerged in the wake of the 2008/2009 global financial crisis, regarding the monetary policy-making. First, should central banks abandon the primary objective of inflation stability? (or, should central banks abandon the inflation targeting regime?). Our answer is clearly “no”. This strategy has proved to be more effective than the others in achieving low and stable inflation, which significantly contribute to macroeconomic, but also financial stability. Besides, we show that while targeting countries are relatively more financially unstable, it is hard to fully impute the responsibility to central banks. Furthermore, the monetary policy response to financial imbalances (through the traditional policy instrument) has been found to be ineffective. Second, is price stability enough? Our response here is also clearly “no”. Financial risks can growth in a context of low and stable inflation. A monetary policy stance consistent with the inflation objective can favor increasing financial risks. However, expand the monetary policy mandate to include a financial stability objective is less likely to be the best approach. Rather, the inflation targeting regime should be complemented with a well-designed prudential framework.

Possible extensions

The work conducted in this dissertation is not free from limitations, and some improvements or possible extensions can be mentioned for future researches.

One of the main issues in empirical analyses on large sample of emerging market economies is certainly data availability. This issue seems to be more critical when looking at financial sector data. We make considerable data collection effort for the purpose of our empirical analyses in this work. However, we recognize that a more in-depth assessment of the financial conditions in emerging countries require additional information related to financial indicators such as house prices, asset prices, currency mismatch or other high frequency financial market data. Those series provide valuable information on the health of the financial sector. With improvement in data availability in more recent periods, future works will be able to overcome those limitations and assess these relevant issues over a longer time dimension.

The theoretical framework used in the fourth chapter of this thesis has the advantage to be very straightforward and intuitive. It allows assessing some important questions in current debates on the monetary policy-making. However, the model can be extended to go one step further and assess other issues related to the policy optimality, welfare analyses or coordination between monetary policy and macroprudential policy. A more complex modeling framework will be needed in this regard, and this will provide a more comprehensive view of those challenges for central banks and the regulatory authorities. The financial risk is capture in our framework through an asset price bubble. Other considerations such as credit gap, house price, or household loans are also relevant and can be considered alternatively in future works. In the same vein, the effectiveness of other prudential instrument can be investigated.

Finally, regarding the concern for external vulnerabilities in merging countries, another approach to assess the policy responses may be to look at the frequency and the magnitude of foreign exchange interventions in those countries. This type of analysis is less likely to be conducted on a large sample of countries (due to data limitations), but a case study on a single economy can be instructive. Furthermore, assessing the potential benefits and costs of those interventions, especially in terms policy credibility for inflation targeting central banks, may be useful for policy implementation.

Résumé en français

L’expérience de la récente crise financière a conduit aussi bien dans la communauté scientifique que dans les banques centrales, à un réexamen de la relation entre politique monétaire et stabilité financière. La présente thèse s’articule autour de la question du risque d’instabilité financière dans un contexte où le principal objectif de politique monétaire est le contrôle de l’inflation.

Historiquement, il semble que la conduite de la politique monétaire ait été menée avec un objectif de stabilisation de l’économie dans sa globalité, tenant compte par conséquent de la stabilité financière. Comme le souligne Goodhart (2010), trois rôles fonctionnels ont, de manière générale, guidé l’action des banques centrales. Le premier est celui du maintien de la stabilité du niveau général des prix. Le second consiste à assurer la stabilité du système financier, et plus largement, à favoriser un développement soutenable du secteur financier. Et enfin, la troisième fonction concerne le financement des autorités publiques. Il s’agit d’assurer ou de facilité l’accès au financement en période de crise, et au contraire de contrôler ou restreindre une mauvaise utilisation du pouvoir de financement de l’Etat en « temps normal ».

Notre travail s’intéresse tout particulièrement à la place de la stabilité financière dans la conduite de la politique monétaire. L’importance accordée à cet objectif de stabilité financière semble avoir évolué en fonction des différents régimes de politique monétaire, et notamment suivant le système monétaire international. Dans une certaine mesure, cette relation a été particulièrement étroite sous le régime de l’étalon-or. La stabilité monétaire était alors assurée par le maintien de la convertibilité en or, qui servait donc d’ancrage nominal. Dans le même temps, les institutions financières étaient tenues de pouvoir mobiliser de l’or ou des actifs facilement convertibles en or, afin d’honorer leurs engagements. Dans ce cadre, l’étalon-or servait donc également « d'ancrage financier », imposant des contraintes sur le secteur financier. Goodhart (1988) souligne d'ailleurs deux principales fonctions de la banque centrale sous ce régime : une fonction « macro » liée à la stabilité monétaire, et une fonction « micro » visant à assurer la stabilité du système financier. La période d'entre-deux-guerres se caractérise par l'émergence d'un processus de libéralisation financière et un important développement de l'activité de crédit des banques, suite à l'effondrement du système de convertibilité-or et une règlementation bancaire encore balbutiante. Il en résulta une période de forte instabilité essentiellement marquée par l'hyperinflation allemande et la grande dépression des années 1930.

Sous le régime de Bretton Woods, le système financier semble avoir été particulièrement stable (Icard, 2007). Cette période caractérisée par un régime *de facto* étalon-dollar était par ailleurs marquée par un cadre monétaire visant à contrôler le crédit à l'économie ainsi que les taux d'intérêt. De plus, suite aux déséquilibres financiers de la période précédente, une règlementation assez contraignante du système bancaire avait été mise en place. Avec la chute du système de Bretton Woods, l'économie mondiale entra dans une phase de transition dans les années 1970-1980, durant laquelle une forte dérèglementation du système bancaire s'opéra. Le cadre de politique monétaire se renouvela également, les agrégats monétaires guidant désormais la politique des banques centrales. Le développement d'une économie de marché, la dérèglementation progressive et le relâchement des précédentes mesures de contrôle du système bancaire, ont conduit à accroitre l'instabilité financière au cours de cette période. Cette phase de transition est également marquée par de fortes pressions inflationnistes, s'expliquant notamment par les deux chocs pétroliers des années 1970. Suite à la rupture de la stabilité de la relation entre les agrégats monétaires et la cible finale (le niveau général des prix), le cadre de politique monétaire entre dans une nouvelle ère à la fin des années 1980.

Le succès des politiques de désinflation mises en place à partir du milieu des années 1980 a contribué à renforcer la place du contrôle du niveau général des prix comme principal objectif des banques centrales. Le cadre de politique monétaire se caractérise alors essentiellement par deux éléments : un objectif principal de stabilité de l'inflation (souvent accompagné d'une cible numérique bien définie), et le taux d'intérêt de court terme comme principal instrument de politique monétaire. Dans un tel contexte, la question de stabilité financière ne fait pas l'objet d'une attention particulière car, il est implicitement admis qu'en assurant la stabilité des prix, les banques centrales renforcent également la stabilité du système financier. Les déséquilibres financiers ne sont alors un sujet de préoccupation spécifique que dans la mesure où ils affectent l'objectif d'inflation. La récente crise financière a cependant remis en cause la pertinence d'une telle conception. En effet, la crise a surgi dans un contexte caractérisé par des niveaux d'inflation assez faibles et stables au niveau mondial. Ceci n'a toutefois pas empêché l'accumulation des déséquilibres financiers qui ont conduit à cette grande crise financière mondiale. Dès lors, il semble primordial de reconsidérer la nature de la relation entre politique monétaire et stabilité financière, et dans une certaine mesure, il s'avère que l'on redécouvre certaines fonctions des banques centrales, notamment l'importance de leur contribution au maintien de la stabilité du système financier.

I. Quelques leçons tirées de la récente crise financière

La crise financière de 2008-2009 a entrainé une remise en cause du cadre de régulation financière existant jusque-là, mais également, et de manière plus large, cette crise a conduit à repenser l'architecture des politiques macroéconomiques, notamment la politique monétaire.

Concernant le cadre prudentiel, il apparait que les déséquilibres financiers qui se sont accumulés au début des années 2000 ont échappé au contrôle du système règlementaire en place avant ce choc financier mondial. Ces déséquilibres s'expliquent (du moins en partie) par un fort accroissement de l'endettement des institutions financières et des ménages au cours de la « grande modération ». D'après les statistiques du FMI, l'endettement des institutions financières dans les pays les plus avancés a plus que triplé en 2007 par rapport à leurs niveaux de la fin des années 1980. L'endettement des ménages aurait quant à lui augmenté d'environ 75% sur la même période (IMF Global Financial Stability Report, 2009). Cette accumulation du risque financier s'explique également par le développement des innovations financières qui implique une sophistication de plus en plus poussée des instruments financiers rendant l'analyse des risques de plus en plus complexe. De plus, la forte intégration financière internationale, la dérégulation, la désintermédiation et le renforcement de la concurrence ont certainement contribué à accentuer les comportements à risque dans la sphère financière. Le cadre prudentiel en vigueur a montré des limites quant à sa capacité à prendre en compte ces développements. Par ailleurs, le renforcement des interconnexions entre les institutions financières, entre différents segments de système financier, mais aussi entre le secteur financier et l'économie réelle, ont souligné les limites de l'approche microprudentielle de la réglementation existante.

Dès lors, au lendemain de la crise, la réforme de ce cadre de régulation apparait comme l'une des plus importantes questions discutées aussi bien dans la sphère académique que parmi les praticiens. La nécessité de s'orienter vers une architecture permettant une analyse systémique des risques, ainsi qu'un cadre de réglementation macroprudentiel, est aujourd'hui largement admise.

En ce qui concerne la conduite de la politique monétaire avant la crise, comme évoqué en amont, les banques centrales ne semblaient pas avoir de préoccupations particulières pour la stabilité du système financier. Tout portait en effet à croire que la stabilité financière découlait de la stabilité macroéconomique. Etant donné que les déséquilibres financiers devraient se manifester à travers des changements du niveau général des prix, il était alors admis qu'en contrôlant l'inflation, les banques centrales assuraient également la stabilité financière. Concernant le secteur financier, la mise en place de mesures préventives de politique monétaire semblait alors peu pertinente. On leurs préférait des actions intervenant après coup, si le risque se matérialise (en cas de crise), afin d'en limiter les effets.

La récente crise des *subprimes* a révélé les limites d'une telle approche, à différent niveaux. Premièrement, cette crise a montré que la stabilité de l'inflation ne suffit à garantir la stabilité financière. En effet, le contexte d'inflation faible et stable du début des années 2000 n'a pas empêché l'accumulation d'importants déséquilibres financiers qui ont conduit à la crise. Deuxièmement, certains arguments soulignent que la conduite de la politique monétaire menée durant cette période serait l'une des causes principales de la crise (Giavazzi et Giovannini, 2010 ; Frankel, 2012). Le cadre de politique monétaire peut créer un environnement propice à l'accentuation de comportements à risque de la part des institutions financières, des entreprises, et des ménages (voir par exemple, Rajan, 2005 ; Adrian et Shin, 2010 ; Hahm et al., 2012 ; Borio et Zhu, 2012). Troisièmement, cette crise a montré que lorsqu'il survient, un choc financier peut avoir des effets extrêmement importants et persistants sur l'économie réelle, perpétuant ainsi une période prolongée d'instabilité économique et financière. Enfin, cette récente expérience a montré que la politique monétaire pouvait être confrontée à d'importantes limites quant à sa capacité à contenir les effets d'un choc d'une telle ampleur. Par conséquent, au lendemain de la crise financière de 2008-2009, reconsidérer l'importance de stabilité financière dans la conduite de la politique monétaire apparait comme une nécessité.

II. L'objectif de ce travail

L'objective de cette thèse est précisément d'analyser dans quelle mesure la question de la stabilité financière ferait l'objet d'une préoccupation particulière dans un contexte où la politique monétaire a pour objectif principal le contrôle de l'inflation (c'est le cas notamment de la stratégie du ciblage d'inflation).

Parmi les grandes questions abordées et traitées dans ce travail, nous examinons dans quelle mesure la nature du régime de politique monétaire aurait fait la différence lors de la récente crise financière mondiale. Comme mentionné précédemment, le cadre de politique monétaire privilégiant la stabilité de l'inflation comme objectif principal des banques centrales a fait l'objet de vives critiques au lendemain de la crise. Cependant, d'autres caractéristiques mises en évidence par la littérature existante, semblent au contraire suggérer que ce cadre de politique monétaire permettrait de mieux faire face à un tel choc financier international, par rapport aux autres régimes monétaires. Nous procédons à une analyse comparative des performances de différents régimes de politique monétaire pendant la récente crise. Malgré l'importance de la question, peu de travaux se sont consacrés à l'étude de l'impact de la stratégie du ciblage d'inflation en période de crise. Notre travail entend pas conséquent répondre à ce déficit.

Nous procédons également à un examen de la relation entre politique monétaire, politique macroprudentielle et stabilité financière. Comme nous l'avons vu, historiquement la conduite de la politique monétaire est liée, certes à différents degrés, à la question de la stabilité financière. La récente crise a souligné d'importantes évolutions de cette relation, qui ne semblent pas avoir été correctement analysées et prises en compte au cours des deux dernières décennies. Dès lors, il parait important d'examiner ces interconnexions entre la sphère financière et la politique des banques centrales. De plus, compte tenu des limites du cadre réglementaire existant avant la crise, la définition d'une nouvelle approche prudentielle et de nouveaux instruments de régulation s'avère nécessaire, pour mieux analyser les risques et les contenir. Du fait du peu d'expérience dans la pratique de cette nouvelle approche s'appuyant sur une perspective macroprudentielle, un examen approfondi de ses contours semble important. Par ailleurs l'émergence de fortes interférences entre ce cadre de régulation et la conduite de la politique monétaire souligne l'importance de la question du cadre institutionnel devant régir la coexistence de ces politiques. A la lumière de ces différents éléments, un examen précis du lien entre stabilité du système financier, politique monétaire et politique macroprudentielle apparait comme primordial.

Discutant du rôle que devrait jouer la politique monétaire pour contribuer à assurer la stabilité financière, des arguments développés à la suite de la crise de 2008-2009 soutiennent que les banques centrales devraient répondre aux déséquilibres financiers (en plus de leur objectif traditionnel de stabilité de l'inflation) à travers l'instrument que constitue le taux d'intérêt de court terme (il s'agit de la stratégie du *leaning against the wind*). Cependant, une autre thèse également développée dans la littérature souligne qu'une telle stratégie génèrerait des arbitrages entre les différents objectifs de politique monétaire. Notre travail vise également à apporter quelques éclaircissements concernant ce débat, en procédant à une analyse de l'existence de conflits d'objectifs lorsque la banque centrale suit une stratégie de *leaning against the wind*. De plus, suivant la discussion que nous avons eue ultérieurement, nous analysons dans quelle mesure l'introduction d'un instrument macroprudentiel permettrait d'améliorer la stabilité du système financier.

Le travail mené dans cette thèse porte une attention particulière au groupe des pays émergents. Au moins deux raisons justifient cet intérêt. Premièrement, un nombre croissant de ces pays ont adopté ou s'orientent vers l'adoption d'un cadre monétaire caractérisé par une politique indépendante et dont l'objectif principal est le contrôle de l'inflation. En effet, parmi l'ensemble des pays ayant adopté le régime du ciblage d'inflation, les trois quarts environ sont des pays émergents et en développement. Par ailleurs, compte tenu des critiques adressées à l'encontre de cette stratégie de politique monétaire à la suite de la récente crise financière, notamment sur la question de la stabilité financière, il semble important d'examiner de plus près la pertinence de ces critiques pour ce groupe de pays émergents, et d'en tirer les conclusions qui s'imposent. En outre, à notre connaissance, aucune analyse n'a été menée jusqu'à présent sur cette relation entre ciblage d'inflation et stabilité financière, dans le cas des pays émergents.

Le second argument justifiant notre intérêt pour les pays émergents est relatif à l'une des principales sources d'instabilité financière pour ce groupe de pays, à savoir leur vulnérabilité aux chocs externes. Du fait d'une intégration de plus en plus forte à la sphère financière internationale, les pays émergents sont plus fortement exposés aux chocs financiers internationaux. Leur niveau de développement financier ne permet cependant pas toujours de faire face à ces chocs de manière satisfaisante. Au demeurant, l'adoption de la stratégie du ciblage d'inflation, qui en principe devrait s'accompagner d'une flexibilité totale du régime de change, est susceptible d'accentuer cette exposition aux chocs externes ; ceux-ci se manifestant à travers une plus forte volatilité du taux de change avec d'importantes conséquences en termes d'instabilité macroéconomique et financière. En particulier, les importantes vagues de flux de capitaux internationaux en direction de ces pays soulèvent de fortes inquiétudes quant à la stabilité de leur système financier. Cette question a fait l'objet d'une grande attention pendant la crise financière de 2008-2009. Dans le sillage de la crise, on a pu observer un déplacement important de capitaux internationaux des pays industrialisés les plus touchés par ce choc, vers les pays émergents. Le sujet reste aujourd'hui une préoccupation majeure pour ces pays, compte tenu du processus de normalisation de la politique monétaire de la FED, et les sorties de capitaux que cela engendre pour les pays émergents. Nous apportons donc quelques éclaircissements sur cette question, en procédant à l'analyse d'une des principales stratégies utilisées par ces pays pour faire face à ce problème : le contrôle du taux de change.

Différentes approches, à la fois statistiques, empiriques (estimations) et théoriques sont utilisées pour procéder à l'analyse des différentes questions exposées ci-dessus. Au-delà de simples analyses graphiques, les méthodes statistiques incluent également l'Analyse en Composante Principal (ACP) qui est une méthode d'agrégation de données sur laquelle nous nous appuyons pour construire un indice composite d'instabilité financière. Par ailleurs, nous avons également eu recours à une analyse en grappe (« clustering analysis ») qui nous permet d'évaluer les dissimilarités et l'hétérogénéité au sein des pays *cibleurs* d'inflation, avant et après l'adoption de cette stratégie de politique monétaire. En ce qui concerne les techniques d'estimation, nous utilisons des méthodes d'étude d'événements et d'analyse d'impact telles que la méthode des Doubles Différences et la méthode d'appariement par les scores de propension (« Propensity Scores Matching » – PSM). Cette dernière approche nous permet de corriger le biais d'auto-sélection associé à l'adoption du ciblage d'inflation, lors des estimations de l'effet de ce régime de politique monétaire sur nos différentes variables d'intérêt. La méthode des moments généralisés (« two stages GMM ») est également utilisée, notamment pour corriger l'éventuel biais d'endogénéité dans nos estimations. Enfin, nous nous appuyons sur des techniques d'estimation à variables dépendantes limitées tels que les modèles Probit et Logit ordonnés sur données de panel avec effets aléatoires. Pour ce qui est du cadre théorique utilisé dans ce travail, notre point de départ est la forme réduite d'un modèle Néo-keynésien standard. Ce modèle traditionnel est enrichi et complété en y introduisant un secteur bancaire ainsi qu'une bulle de prix d'actifs endogène. Le cadre théorique ainsi obtenu nous permet alors d'analyser différentes interactions entre politique monétaire et politique macroprudentielle, ainsi que leurs effets sur l'environnement macroéconomique et financier, suite à des chocs macroéconomiques et financiers.

III. Structure de la thèse

Cette section vise à résumer brièvement les différents chapitres de la thèse.

Le **chapitre I** a pour objectif de procéder à une analyse de la relation entre politique monétaire, politique macroprudentielle et stabilité financière. Ce chapitre commence par discuter du cadre de politique monétaire, principalement orienté vers un objectif de stabilité de l'inflation, et qui a prévalu au cours des deux décennies précédant la crise financière mondiale. Suite aux critiques adressées à l'encontre de cette politique des banques centrales au lendemain de la crise, nous tentons d'examiner dans quelle mesure la politique monétaire pourrait contribuer à accentuer le risque d'instabilité financière, ou au contraire réduire ce risque. Une politique monétaire laxiste peut créer un environnement favorable au développement de comportements à risque à travers le canal de la prise de risque, la recherche de rendements, une hausse de l'endettement du secteur privé (entreprises et ménages), ou encore la hausse des prix d'actifs pouvant déboucher sur une bulle financière. A contrario, des arguments avancés avec force après la récente crise soutiennent que la stratégie du *leaning against the wind* devrait être adoptée par les banques centrales pour faire face aux risques financiers. Compte tenu des limites relatives à cette stratégie évoquées préalablement, nous introduisons une discussion sur le cadre macroprudentiel qui représenterait alors une meilleure alternative de réponse au risque d'instabilité financière.

L'objectif d'une politique macroprudentielle est de contenir le risque systémique. Cette approche présente l'avantage de reposer sur un large ensemble d'instruments prudentiels pouvant être utilisés pour répondre à des types ou sources de risque bien spécifiques. Nous soulignons par ailleurs que l'efficacité de cette approche dépend très fortement de la capacité à détecter et analyser correctement les risques. La définition du cadre institutionnel est également une question primordiale dans la mise en place d'une politique macroprudentielle. A cet égard, nous examinons les avantages et les inconvénients des approches de type « règle » *versus* « discrétion » en ce qui concerne l'implémentation du cadre prudentiel. Nous discutons également la question de la gouvernance de la politique prudentielle (en comparant le « modèle banque centrale » où la banque centrale est en charge à la fois de la conduite de la politique monétaire et de la politique prudentielle, à un modèle dans lequel une seconde institution serait en charge de la mise en place du cadre prudentiel). Quel que soit le cas, nous soutenons qu'une coordination étroite doit exister entre politique monétaire et politique prudentielle, pour atteindre les objectifs de stabilité macroéconomique et financière.

Ce premier chapitre a introduit une discussion liée au principal objectif de stabilité de l'inflation régissant la politique monétaire, et la question de la stabilité financière. Dans le contexte de la récente crise financière, le **chapitre II** analyse les performances des pays *cibleurs* d'inflation, comparativement aux autres. Ce chapitre commence par une présentation générale du régime de ciblage d'inflation, en fournissant des éléments de définition, en discutant du cadre théorique qui sous-tend cette stratégie de politique monétaire, ainsi que quelques aspects pratiques concernant son implémentation. Pour ce qui est de l'analyse comparative de l'effet du ciblage d'inflation en période de crise, notre argumentation s'appuie sur des conclusions issues de la littérature et suggérant que l'on peut s'attendre à de meilleures performances de ce régime de politique monétaire. En effet, celui-ci serait associé à des conditions macroéconomiques initialement plus favorables (meilleurs équilibres budgétaire et externe, meilleure situation d'endettement, faibles volatilité du taux de changes) ; mais aussi à une crédibilité plus forte des banques centrales et des taux d'intérêt initialement plus élevés, ce qui donne plus de marge de manœuvre pour la conduite d'une politique accommodante en réponse à un choc.

L'analyse empirique repose sur un cadre rigoureux qui s'appuie sur la méthode des doubles différences, suivant Ball et Sheridan (2005). Les estimations portent sur un échantillon de 67 pays développés et en développement, dont 20 pays *cibleurs* d'inflation. Les principaux résultats montrent que les banques centrales *cibleuses* d'inflation ont été mieux à même de contenir les conséquences de la récente crise financière telles que la hausse de la volatilité de l'inflation, la hausse des taux d'intérêt réels, ainsi que les risques déflationnistes. L'ajustement à la baisse des taux d'intérêt directeurs, en réponse au choc, semble également avoir été plus important pour ces banques centrales. Cependant, en considérant les performances macroéconomiques au sens large (en termes de croissance du PIB), il semble que le ciblage d'inflation n'ait pas fait la différence pendant la crise de 2008-2009. En effet, les résultats suggèrent que la baisse de la croissance économique n'a pas été significativement différente entre *cibleurs* et *non-cibleurs*.

Une des explications possibles à ce dernier résultat quelque peu décevant de l'effet du ciblage d'inflation serait que les pays *cibleurs* abordent la crise avec des secteurs financiers relativement plus fragiles[104]. Dans le **chapitre III,** nous analysons de manière plus précise cette question. Ce chapitre tente principalement de répondre à deux questions. D'abord, l'adoption du régime du ciblage d'inflation peut-elle être associée à une instabilité financière relativement plus forte dans ces pays ? Ensuite, cette forte instabilité financière peut-elle s'expliquer par le fait que les banques centrales pratiquant le ciblage d'inflation sont moins réactives aux déséquilibres financiers, relativement aux autres banques centrales ? Cette analyse est menée sur un échantillon de 26 pays émergents, dont 13 *cibleurs* d'inflation, en utilisant des données trimestrielles sur la période 2000 – 2010. Le chapitre commence par une première étude statistique et comparative des conditions financières entre *cibleurs* et *non-cibleurs*, pour différents groupes régionaux (Asie, Europe, Amérique Latine, Afrique et Moyen Orient). Ensuite, nous discutons de la difficulté à analyser et mesurer l'instabilité financière, et soutenons que s'appuyer sur de simples indicateurs (tels le ratio crédit bancaire/PIB ou encore le taux de croissance du crédit) ne donne qu'une vision très partielle des conditions financières réelles. A cet égard, nous proposons un indice composite

[104] Comme cela a été évoqué précédemment, d'importantes critiques à l'encontre de cette stratégie de politique monétaire suggèrent qu'en se focalisant sur leur objectif de stabilisation de l'inflation, les banques centrales *cibleuses* d'inflation auraient négligé le développement des risques dans le secteur financier. Une fragilité plus importante du secteur financier dans les pays *cibleurs* pourrait avoir compensé (au moins en partie) les effets bénéfiques attendus du ciblage d'inflation pendant la crise.

d'instabilité financière, construit à partir d'un ensemble plus large d'indicateurs prenant en compte différents aspects du risque dans le système financier. Les résultats de nos estimations à partir des GMM et du PSM suggèrent qu'en moyenne, l'instabilité financière est plus forte dans les pays émergents *cibleurs*, par rapport aux *non-cibleurs*.

La dernière partie de ce chapitre vise à comparer *cibleurs* et *non-cibleurs* d'inflation, en ce qui concerne la réactivité des banques centrales aux déséquilibres financiers. Pour cela, nous estimons des fonctions de réactions de type règle de Taylor, augmentées d'un indicateur d'instabilité financière. Ces fonctions de réaction sont estimées à la fois pour les groupes de pays *cibleurs* et *non-cibleurs* (en s'appuyant sur une analyse en données de panel), mais aussi pour chaque banque centrale ayant adopté le ciblage d'inflation. Ces estimations prennent en compte le fait qu'il pourrait y avoir des asymétries dans les réponses des banques centrales[105]. Nous faisons par ailleurs un certain nombre d'hypothèses sur le *timing* de la réponse de ces banques centrales. Globalement, en considérant à la fois des indicateurs simples et plus standards d'instabilité financière, ainsi que notre indice composite, les résultats suggèrent que les banques centrales *cibleuses* d'inflation sont plus réactives à l'instabilité financière que les autres.

Les conclusions du précédent chapitre suggèrent qu'en dépit d'une réactivité plus forte des banques centrales aux déséquilibres financiers, le système financier des pays *cibleur*s d'inflation est en moyenne plus fragile que celui des autres. Cette conclusion, dans une certaine mesure, remet en cause l'efficacité de la stratégie du *leaning against the wind*. Le **chapitre IV** vise précisément à analyser cette question. A cet égard, nous procédons en deux étapes. Premièrement, nous examinons l'existence de conflits d'objectifs dans un contexte où l'autorité monétaire réagit aux déséquilibres financiers, en plus de son objectif principal de stabilité de l'inflation. Pour cela, l'analyse s'appuie sur un cadre théorique dont le point de départ est la forme réduite du modèle Néo-keynésien. Nous introduisons ensuite une bulle de prix d'actifs qui capture l'accumulation du risque dans le secteur financier. Pour *endogénéiser* ce processus de bulle, et suivant la discussion du chapitre I, nous faisons l'hypothèse que le développement du risque financier peut être influencé par la politique monétaire, et plus précisément par le taux d'intérêt à court terme. De plus, la bulle affecte la demande agrégée à

105 Notamment le fait qu'une réaction à l'instabilité financière pourrait être conditionnée par l'atteinte de l'objectif principal de stabilité de l'inflation.

travers différents canaux. Nous analysons l'évolution des volatilités de l'inflation, de l'*output gap* et de la bulle, pour différentes réponses de politique monétaire face à différents types de chocs. Les résultats de ces premières simulations suggèrent que le *leaning against the wind* génère un arbitrage entre l'objectif traditionnel de stabilité macroéconomique des banques centrales, et le nouvel objectif de stabilité financière.

Cette limite du cadre de politique monétaire traditionnel à assurer simultanément la stabilité macroéconomique et financière, dans une certaine mesure, soutient l'argument selon lequel de nouveaux instruments (macroprudentiels) seraient plus appropriés pour faire face au risque d'instabilité financière. La seconde partie de ce chapitre examine donc dans quelle mesure l'introduction d'un instrument prudentiel permettrait d'améliorer les résultats précédents. Pour cela, le cadre théorique est enrichi en y ajoutant un secteur bancaire. Nous faisons l'hypothèse que la bulle de prix d'actifs est alimentée par du crédit bancaire. Dès lors, l'instrument prudentiel introduit prend la forme d'une contrainte de capital pour les banques (exigences de capital fixes ou contracycliques) visant à contrôler le crédit à l'économie, et donc à réduire le risque d'instabilité financière. Les principaux résultats issus de ce nouveau cadre théorique peuvent être résumés comme suit. D'abord l'introduction d'un instrument prudentiel permet de mieux assurer la stabilité du secteur financier. Ensuite, les exigences en capital contracycliques semblent plus efficaces (par rapport aux exigences en capital fixes) pour contenir le risque financier. Enfin, un cadre reposant sur un double pilier, où en plus de la mise en place d'une politique prudentielle, la banque centrale est plus attentive au développement des risques financiers, serait globalement plus efficace pour assurer à la fois la stabilité macroéconomique et la stabilité financière.

Les réponses prudentielles et/ou de politique monétaire aux risques financiers doivent être adaptées aux différentes sources de ces risques. La vulnérabilité aux chocs externes, qui se manifeste à travers de fortes variations de changes, constitue une des sources importantes du risque d'instabilité financière pour les pays émergents. A cet égard, le **chapitre V** examine dans quelle mesure le contrôle du taux de change est utilisé dans ces pays, comme instrument prudentiel, pour faire face à cette source de risque. Pour souligner l'importance de cette question, nous montrons qu'en dépit du fait que certains de ces pays s'engagent à adopter un régime de change totalement flexible (excluant ou limitant fortement des interventions sur le marché des changes), lorsque les conditions financières se détériorent (hausse de la fragilité du système financier), des tentatives de contrôle du taux de change sont entreprises pour réduire l'exposition aux risques externes. Pour illustrer ceci, nous commençons par identifier ces pays qui, en principe (ou du moins en théorie), devraient avoir un régime de change totalement flexible. Les pays ayant adopté la stratégie du ciblage d'inflation constituent une référence intéressante à cet égard[106].

Ensuite, nous analysons dans quelle mesure ces pays sont amenés à dévier de cet engagement initial pour la flexibilité du régime de change. L'étude est menée sur un échantillon de 36 pays émergents, dont 16 *cibleurs* d'inflation, avec des données couvrant la période 1985 – 2010. Les techniques d'estimation en données de panel s'appuient sur des modèles à variables dépendantes limitées (tels que le logit et probit ordonnés à effets aléatoires). Nous utilisons également des méthodes d'analyse d'impact (diverses approches du PSM). Les résultats montrent que les pays *cibleurs* d'inflation dont l'environnement financier et macroéconomique est relativement moins solide, ceux dont les secteurs financiers sont les plus vulnérables aux chocs externes, sont également ceux qui utilisent le contrôle du change comme instrument prudentiel. En particulier, la probabilité d'intervention sur le marché des changes augmente avec le niveau d'exposition du système bancaire aux risques externes, mais aussi le niveau de dette externe de ces pays.

[106] Premièrement, en moyenne la flexibilité du régime de change est plus forte dans les pays émergents *cibleurs* d'inflation, par rapport aux autres. Deuxièmement, et c'est le plus important, l'adoption de cette stratégie de politique monétaire est supposée être associée à un régime de change totalement flexible. Ceci visant à renforcer la crédibilité et l'efficacité de la stratégie du ciblage d'inflation.

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Armand FOUEJIEU AZANGUE

Stabilité Financière et Stabilisation de l'Inflation

Résumé :

La crise financière de 2008-2009 a conduit à reconsidérer la relation entre politique monétaire et stabilité financière, soulignant la nécessité pour les banques centrales d'être plus attentives aux risques financiers. Cette crise a également mis en évidence les limites du cadre de régulation (micro) prudentielle existant, renforçant ainsi l'importance d'une approche macroprudentielle visant à contenir le risque systémique. La présente thèse s'articule autour de ces questions. L'objectif est d'analyser dans quelle mesure un cadre de politique monétaire avec pour objectif principal la stabilité des prix (tel le ciblage d'inflation), pourrait accentuer le risque d'instabilité financière. Il s'agit en outre de souligner et discuter le rôle que peuvent jouer les politiques monétaire et macroprudentielle pour assurer et renforcer la stabilité du secteur financier *(Chapitre I)*. Les résultats de l'analyse suggèrent que les banques centrales *cibleuses* d'inflation ont été mieux à même de contenir les conséquences de la récente crise financière *(Chapitre II)*. Cependant, il semble que le risque d'instabilité financière soit plus fort au sein des pays émergents *cibleurs* d'inflation (comparé aux *non-cibleurs*), malgré les réponses des banques centrales aux déséquilibres financiers *(Chapitre III)*. Ceci remet en cause l'efficacité de la stratégie du *leaning against the wind*. Nos conclusions montrent que cette stratégie génère un conflit d'objectif entre stabilité macroéconomique et stabilité financière. La mise en place d'un cadre macroprudentiel efficace, associé à une politique monétaire plus sensible aux risques financiers, permettrait de garantir un environnement économique globalement plus stable *(Chapitre IV)*. Par ailleurs, il apparait que les pays émergents *cibleurs* d'inflation s'appuient sur le contrôle du taux de change pour faire face à la forte vulnérabilité de leur système financier aux chocs externes; ceci en dépit de l'exigence de flexibilité du change que requiert cette stratégie de politique monétaire *(Chapitre V)*.

Mots clés : politique monétaire, politique macroprudentielle, ciblage d'inflation, stabilité financière, leaning against the wind, arbitrages, contrôle du change.

Financial Stability and Inflation Stabilization

Abstract:

The 2008/2009 global financial crisis has revived the debate on the concern for financial stability in the monetary policy-making, stressing the need to reconsider the role of central banks in ensuring financial stability. The crisis has also pointed some flaws in the existing (micro) prudential regulation and the relevance to move toward a broader regulatory framework aiming to prevent systemic risk. This thesis is built upon these issues. It investigates the extent to which financial stability may be of particular concern in a context where the main monetary policy objective is inflation stabilization (typically, in an inflation targeting regime –IT–). It further assesses how the macroprudential framework and monetary policy can be articulated to ensure the best outcome in terms of macroeconomic and financial stability *(Chapter I)*. The conclusions derived from this work suggest that, faced with the recent global financial turmoil, inflation targeting central banks have been more able to mitigate the shock, certainly thanks to higher policy credibility *(Chapter II)*. However, we evidence that IT countries (especially in EMEs) are more financially vulnerable than their non-IT counterparts, despite central banks' response to financial risks *(Chapter III)*. Following the latter conclusion, we investigate more closely the effectiveness of the *leaning against the wind* strategy. We show that such a policy response generates trade-offs between the financial and macroeconomic stability objectives of the monetary authorities. The best stabilization outcome is achieved when an effective macroprudential framework is implemented, combined with higher central bank's concern with financial risks *(Chapter IV)*. Furthermore, we show that in EMEs ITers, foreign exchange interventions are used to mitigate their financial vulnerability to external shocks, although the IT regime requires a fully floating exchange rate regime *(Chapter V)*.

Keywords: monetary policy, macroprudential policy, inflation targeting, financial stability, leaning against the wind, trade-offs, foreign exchange interventions.

LÉO

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