Macro-Prudential Policy and the Conduct of Monetary Policy

Denis BEAU, Laurent CLERC and Benoît MOJON

January 2011

Abstract:

In this paper, we analyse the interactions between monetary and macro-prudential policies and the circumstances under which such interactions call for their coordinated implementation. We start with a review of the interdependencies between monetary and macro-prudential policies. Then, we use a DSGE model incorporating financial frictions, heterogeneous agents and housing, which is estimated for both the euro area and the United States over the period 1985 -2010, to identify the circumstances under which monetary and macro-prudential policies may have compounding, neutral or conflicting impacts on price stability. We compare inflation dynamics across four "policy regimes" depending on: (a) the monetary policy objectives – that is, whether the policy instrument, the short-term interest rate factors in financial stability considerations by leaning against credit growth; and (b) the existence, or not, of an authority in charge of a financial stability objective through the implementation of macro-prudential policies that can "lean against credit" without affecting the short-term interest rate.

Our main results are: (1) under most circumstances, macro-prudential policies have a limited effect on inflation; (2) the policy regime impacts inflation dynamics mainly in the case of financial shocks (shocks to asset prices and credit); (3) under those circumstances, the best outcome in terms of price stability is achieved by combining an independent monetary policy strictly focused on price stability and an independent macro-prudential policy leaning against credit growth; (4) the performance of this policy regime, where monetary policy and macro-prudential policies have separate assignments in terms of objectives, is improved upon if monetary policy takes into account any macro-economic effects resulting from macro-prudential policies. Finally, we assess the extent to which the new institutional arrangements adopted in Europe or proposed in the US and the UK would effectively facilitate coordination and information-sharing between the central bank and the macro-prudential authority. Indeed, as shown in our model-based simulation, the better informed the central bank about macro-prudential policy, the more likely it is to be able to preserve price stability.

Keywords: Monetary Policy; Financial Stability; Macro-prudential Policy; ESRB

JEL codes: E51, E58, E37, G13, G18

This paper benefited from the efforts of several colleagues from the Banque de France Monetary Policy Division (POMONE). We are particularly grateful to Pamfili Antipa and Eric Mengus. We are also grateful to Jean-Pierre Landau and Pierre Jaillet for comments and suggestions on earlier drafts. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Banque de France. All remaining errors are ours.

1. Introduction

The "Great Contraction" in global economic activity triggered by the financial crisis, and the extraordinary fiscal and monetary measures that public authorities had to undertake in order to put the economy back on a growth path by putting public finances under heavy strains and leading to extremely low short-term interest rates, have shown the enormous costs resulting from an unstable financial system.

Such costs have triggered a wide-ranging review of financial-stability policies. An important outcome of such a review is the strengthening of policies and instruments focused on macro-financial stability, the so-called "macro-prudential policies".

The deployment of such policies may however raise important coordination issues with other stability-oriented policies, ranging from micro-prudential to monetary policies. Such coordination issues stem from the interdependencies between these policies, in terms of both objectives and transmission mechanisms.

The aim of this paper is to explore the coordination issues raised specifically by the cyclical effects of macro-prudential and monetary policies[1] Under this perspective, we address the following three questions:
(1) Do the likely interactions between macro-prudential policies and monetary policy create a risk of conflicts in the pursuit of financial stability and price stability?
(2) Under what circumstances coordination in the implementation of such policies is advisable?
(3) How to best ensure the effectiveness of such coordination when it is needed?

The paper is organised as follows. In section 2 we discuss the possible interactions between macro-prudential and monetary policies, whereas in section 3, we present results from simulations conducted with DSGE models estimated based on both euro area and US data over the period 1985-2010. These simulations allow us to assess the circumstances under which macro-prudential and monetary policies may have compounding, neutral or conflicting outcomes on financial and price stability. We then investigate the most efficient policy mix under these circumstances. Finally, in section 4, we assess the extent to which the new institutional arrangements adopted in Europe, or proposed in the US and the UK, would facilitate coordination and information-sharing amongt the institutions involved.

2. The interactions between macro-prudential and monetary policies and the risk of conflicting impact on financial and price stability

2.1 The new role of macro-prudential policies in financial-stability regulatory frameworks

The financial crisis has shown that neither market discipline nor regulation and supervision of the financial system's main components (i.e. institutions, markets and infrastructures) can prevent systemic risk, i.e. the risk that disruptions to financial services' activities may have serious negative consequences on the stability of the financial system as a whole, and therefore of the real economy.

[1] The objective of macro-prudential policies are both preventing the build-up of systemic risk, and mitigating its impact on the economy. There are two dimensions to this: First, improving the resilience of the financial system, by limiting the contagion effect due to "bank runs", asset fire sales and externalities phenomena, improving infrastructures and monitoring aggregate risk. Second,limiting the risk of spillovers of financial instability on the business cycle and the real economy. In this paper, we focus exclusively on this second dimension of macro-prudential policies, which are the most likely to interfere with monetary policy's goal to stabilize prices.

In order to better limit the likelihood and impact of systemic risk, a reform of the international regulatory framework is underway. Its objective is to better guarantee the stability of the financial system as a whole, not just of components. [2] A key element of that reform, beyond strengthening the supervision of individual financial institutions, the oversight of key market infrastructures and the monitoring of the functioning of financial markets, is the strengthening of the role of so-called "macro-prudential" policies, namely policies that focus on the interactions between financial institutions, markets, infrastructure and the business cycle".[3]

In September 2010, the Basel Committee for Banking Supervision (BCBS) proposed an important step in the reform of the international regulatory framework. The G20 Leaders endorsed such proposal at their Seoul summit in November 2010. Beyond significantly strengthening micro-prudential requirements in terms of capital, liquidity and leverage, the BCBS agreed on the introduction of a so-called "macro-prudential overlay",[4] which has two dimensions.

First, it seeks to reduce the banking system's tendency to amplify the ups and downs of the business cycle through the excessive credit supply and excessive credit cutbacks which typically arise in periods of financial exuberance and financial stress, respectively. Tools to be used to that effect notably include a capital conservation (which will prevent banks from making inappropriate distribution when their capital declines) and a countercyclical capital buffer (which will compel banks to increase their capital base during periods of excessive credit growth).

Second, it seeks to limit the transmission of shocks across the financial system. Tools to be used to that effect are still being debated, but they will most likely combine capital surcharge, bail-in debt and contingent capital for systemically important financial institutions (SIFIs).

2.2 The interdependencies between macro-prudential and monetary policies

Macro-prudential and monetary policies pursue two different objectives, namely financial stability and price stability. Following the standard Tinbergen principle, two separate (sets of) instruments allow authorities to implement the two policies. Turning to the allocation of instruments to objectives, the Poole (1970) principle of comparative efficiency provides the natural analytical benchmark. There is a broad consensus that monetary policy tools (e.g. central bank money supply conditions) are the natural ones for pursuing price stability. Additional tools, such as time-varying countercyclical capital requirements, should be used to implement macro-prudential policies that will help to preserve financial stability. This is consistent with the "principle of effective market classification" made popular by R. Mundell (1962) according to which "policies should be paired with the objectives on which they have the most influence."

In principle, such an allocation of policy instruments to the two objectives would limit the need of policy coordination. In practice, however, having two separate sets of instruments may not necessarily prevent situations in which they interact, and may therefore have compounding or conflicting effects on the objectives they pursue. Moreover, the literature also points out that fully optimal policy would call for coordination when spillovers are large enough.

In this paper we take the view that the implementation of macro-prudential policies will at the very least impact upon, and therefore alter, the transmission mechanism of monetary policy. The main reason for this is that macro-prudential policies will (partly) work through the very same transmission channels as monetary policy, the most likely being the bank lending and the balance sheet channels (see Table 2.1 below for an overview), and, exactly as monetary policy, are intended to modify private agents' behaviour.

[2] See H. Hannoun: "Towards a global financial stability framework" 45th SEACEN Governors' Conference, 26-27 February 2010

[3] See CGFS "Macro-prudential instruments and frameworks: a stocktaking of issues and experiences" May 2010

[4] See N. Wellink " A new regulatory landscape", *16th International Conference of Banking Supervisors* ,22 September 2010

Table 2.1: Macro-prudential instruments and monetary policy transmission channels

Vulnerability	Financial system component		Envisaged macro-prudential tool	Transmission channels
Leverage	Bank / deposit taker	Balance sheet	• Capital ratio • Risk weights • Provisioning • Profit distribution restrictions • Credit growth cap	Bank lending Broad credit Balance sheet
		Lending contract	• LTV cap • Debt service/income cap • Maturity cap	Bank lending
	Non-bank investor			
	Securities market		• Margin/haircut limits	Collateral
	Financial infrastructure			
Liquidity or market risk	Bank / deposit taker	Balance sheet	• Liquidity/reserve requirements • FX lending restrictions • Currency mismatch limit • Open FX position limit	Bank lending Balance sheet
		Lending contract	• Valuation rules	Balance sheet Collateral
	Non-bank investor		• Local currency or FX reserve requirements	Balance sheet
	Securities market		• Central banks balance sheet operations	Collateral Portfolio
	Financial infrastructure		• Exchange trading	
Inter-connectedness	Bank / deposit taker	Balance sheet	• Capital surcharge for SIFIs	Bank lending
		Lending contract		
	Non-bank investor			
	Securities market			
	Financial infrastructure		• Central counterparty	Interest rate

Source: CGFS (2010) and Banque de France

The likelihood of an interaction between macro-prudential and monetary policies originates from the focus of, macro-prudential policies -on monetary and financial institutions[5]. These institutions turn out to be central banks' counterparts in their provision of liquidity to the economy.

[5] The scope of macro-prudential policies should in principle be broad as regulations currently under preparation shall make the new regulatory agencies responsible for the macro-prudential oversight of all types of financial intermediaries, including the shadow banking system, markets, products and infrastructures. However, collecting comprehensive information and assessing the financial risk on all these dimensions may prove challenging. By focusing on the regulated sector, but monitoring the links between the regulated and the unregulated parts of the financial system, through contingent credit lines, franchises, out-of-balance sheet movements or agreements etc., the macro-prudential authority should have an effective lever on the whole financial system.

2-3 The risks of conflicting interactions

Whether macro-prudential and monetary policies may have complementary, conflicting or independent outcomes on financial and price stability will depend on the type and diffusion of supply and demand imbalances across the financial system and the real economy (see table 2.2 below).

A typical example of a conflicting impact would be a situation in which an asset bubble has been identified, while there are strong risks to price stability on the downside. In other words, supply and demand are misaligned in both the financial system and the real economy, but in opposite directions. In that case, macro-prudential policy should aim at restricting credit and liquidity growth, but this could lead to an undesired contraction in aggregate activity, and to increased downside risks to price stability. The macro-prudential policy would then contribute positively to meet the financial stability objective, but would have an adverse impact on the price stability objective, calling for a policy response, possibly a loosening of the monetary policy stance.

Such a loosening of the monetary policy stance, however, may in turn have an adverse impact on the financial stability objective. Lower interest rates could indeed contribute to the build-up of financial imbalances *via* the so-called 'risk-taking' channel.[6] Simply put, very low interest rates may create incentives, for banks, to take on more risk, through the interplay of various channels including asset substitution, search for yield, pro-cyclical leverage and risk shifting[7], when banks operate under asymmetric information and limited liability.

Recent research has provided empirical evidence in favour of existence of such a channel. It has been documented,[8] for example, how market-based measures of banks' risks as perceived by financial market participants tend to react positively to changes in interest rates, so that a lower interest rate leads investors to perceive banks as comparatively less risky. By the same token, several papers[9] have shown that credit standards are correlated with the level of interest rates: lower interest rates, in particular, imply lower credit standards including to customers who are perceived as representing a higher credit risk. Research carried out at the Banque de France[10] has shown that, when the regulatory environment is not transparent, a decrease in the level of the real interest rate increases banks' risk-taking behaviour, partly because it may facilitate the under-pricing of risks which is typical when asset prices rise.

An alternative channel through which low rates may contribute to the building up of financial imbalances originates from central banks' ultimate focus on goods and services' prices rather than on asset prices. During the pre-subprime crisis period, characterized by big supply shocks originating from the integration of large developing countries into the global economy, the resulting disinflationary pressures induced central banks to keep nominal interest rates at historically low levels, which, with the benefit of hindsight, may have contributed to excessive credit growth, with the resulting creation of asset price bubbles.[11]

Overall, Mundell's separate-assignment principle to formulating monetary and macro-prudential policies should therefore not be understood as necessarily implying that coordination is not needed. On the contrary, it should lead to the conclusion that monetary policy decisions need to take into account the macroeconomic effects of macro-prudential policies and vice versa.[12] In section 3 we resort to estimated DSGE models to illustrate this point.

---

6 See Rajan (2006) and Borio and Zhu (2008).

7 See De Nicolo, *et al.* (2010)

8 See Altunbas, Gambacorta and Marques (2010).

9 See Vasso *et al.* (2008) and Ciccarelli, Maddaloni and Peydro (2009).

10 See Dubecq, Mojon and Ragot (2010).

11 See Taylor (2009) and Obstfeld and Rogoff (2009).

12 See Yellen J. L. (2010): "Macro-prudential Supervision and Monetary Policy in the Post-crisis World", Remarks at the Annual Meeting of the National Association for Business Economics, October, 11.

Table 2.2: Likely instances of conflicts between monetary and macro-prudential policies

	Inflation above target	Inflation close to target	Inflation below target
Financial exuberance (boom)	Complementary	Independent	Conflicting
No imbalance	Independent	Independent	Independent
Financial deflation (bust)	Conflicting	Independent	Complementary

3. Lessons from model-based simulations

In this section we use model-based simulations to identify the circumstances under which macro-prudential and monetary policies may have compounding, neutral or even conflicting outcomes on financial and price stability. We investigate the most efficient policy mix under such circumstances.

3.1 The approach followed and the characteristics of the models used

A literature review

Economists typically use General Equilibrium models to assess the relative merits of alternative economic policies. In macroeconomics, these models are the most widely used analytical tools in order to describe the effects of alternative monetary policies on the business cycle and inflation. In this context, the decisions of consumers and firms can be described as deriving from intra-temporal and inter-temporal maximization of their utility and profits given their preferences and the state of technology.

Usual assumptions are that households supply labour and allocate their income into consumption and investment within period and over time, while firms combine labour and capital into output. In addition, it is typically assumed that all prices and wages cannot be reset every period (prices and wages are sticky) because of nominal rigidities. Such rigidities open the way to the non-neutrality of monetary policy. The most attractive feature of such models is that their behavioural patterns are independent of government policies. They can therefore be used in order to compare alternative monetary policies, or their interplay with macro-prudential policies.

These models, however, have several drawbacks (see Appendix III for a comprehensive review). Their dynamical properties, and therefore the relative performance of alternative policies, depend on parameters, the estimates of which remain largely uncertain. More to the point of this paper, only recently have these models imbedded a description of the financial sector (see Appendix I for a survey of this literature).

This is usually done in the following way. Credit is modelled as a determinant of either physical capital accumulation or housing investment because of the existence of some form of asymmetric information. Hence, borrowers can issue credit only up to the value of their collateral (see Bernanke, Gertler and Gilchrist, 1999 or Iacoviello, 2005).[13] The availability and the cost of credit can influence aggregate demand, the output gap and inflation. One can therefore use such models to analyze how the cyclical component of macro-prudential policies, which are expected to mainly consist of leaning against credit developments, impact upon business-cycle dynamics, and therefore price stability.

[13] Recent contribution investigate more extensively the role of the financial structure, including a focus on bank capital (Dib, 2010; Meh and Moran, 2010a; Angelini, Neri and Panetta, 2010, and references therein. See also Curdia and Woodford [Year ?]; de Fiore and Tristani; [Year ?] Karadi and Gertler; Gertler [Year ?] and Kiyotaki and Queralto[Year ?].

As of today, only very few papers[14] propose a formal assessment of the effects of macro-prudential policies on price stability. In a recent contribution, N'Diaye (2009) shows that raising capital requirements during periods of economic boom can dampen the financial accelerator mechanism. Hence, macro-prudential policies may facilitate the stabilization of inflation, and hence the task of the monetary policy authority. This conclusion, however, may not carry through under all types of economic circumstances. If the economy is predominantly driven by shocks that move inflation and credit in opposite directions, then policies that aim at stabilizing credit may in turn destabilize inflation.

Box 1: Leaning Against the Wind? Long-standing debate and views

The considerations of the role played by monetary policy in contributing to a financial stability objective echo a long standing debate on the desirability and feasibility of a policy response to asset price bubbles. With respect to the desirability of an active role, some among the proponents of "benign neglect" question public authorities' legitimacy assessing the fundamental value of asset prices, mainly because, unlike investors, such authorities are not risking their own money. The market would efficiently keep asset prices in line with, or at least not too far from, their fundamental value. Modifying the stance of monetary in response to asset prices may therefore impair market efficiency.

Turning to feasibility, some (e.g. Bernanke and Gertler, 1999) argue (in a relatively recent occurrence of this debate, at the time of the dot com bubble) that monetary policy should respond to asset prices only to the extent that influence expected inflation. The authors claim that the effects of asset price fluctuations on price inflation are too irregular for monetary policy to lean against them. The then Chairman of the Fed, Alan Greenspan (2002) argued that asset price bubbles could be detected only ex post, after asset prices have collapsed. Monetary policy should therefore lean against the wind only in this downward phase of asset price cycles, in order to prevent their deflationary consequences. This doctrine came to be known as the "Greenspan put", in the sense that speculators could expect the support of the Fed, in the form of lower interest rates, if asset prices were to collapse.

On the opposite side of the trenches, over the past decade, several authors have contended that monetary policy should lean against the wind ex ante. Cecchetti, Genberg, Lipsky and Wadhwani (2000) show that allowing the policy instrument to react to asset prices will reduce the likelihood of asset price misalignments, and the associated risks to economic stability. Goodhart and Hofmann (2002) argue that monetary policy should stabilize the purchasing power of money not only vis-à-vis the price of the current consumer basket, but also with respect to any asset that can be purchased with money. Borio and Lowe (2002) argue that a monetary policy response to financial imbalances as they build up may be both possible and appropriate under certain circumstances. Finally, Bean (2003) contends that a forward-looking flexible inflation targeting central bank should take into consideration long run effects of bubbles and financial imbalances in the setting of current interest rates.

The current crisis has clearly shaken the efficient markets hypothesis, which was one of the key intellectual rationales behind the benign-neglect position. The other arguments in favour of benign neglect, however, cannot be easily dismissed. First, identifying financial imbalances in real time remains a very difficult task. Second, changes in the monetary policy instrument, i.e. the level of short-term interest rates, may either have little impact on financial imbalances, or be very costly in terms of the price stability objective.

Concerning the identification of financial imbalances in real time, the main argument advanced by the proponents of the benign-neglect position is that a monetary policy response to perceived financial imbalances could be desirable only if central banks were better informed than the private sector about

[14] Most contributions are recent if not very recent. See Kannan, Rabanal and Scott (2009), N'Diaye(2009), Angeloni and Faia (2010), Gerali et al. (2009), Angelini, Neri and Panetta (2010), Gertler, Kiyotaki and Queralto (2010), Cecchetti and Kohler (2010), and Antipa, Mengus and Mojon (2010). See also Kashyap and Stein (2010), Fahr S., Rostagno, Smets F. and Tristani O. (2010).

the 'fundamental price' on financial markets, which is unlikely to be the case in practice. Although the consensus remains that identifying financial imbalances is indeed a very difficult task, this argument has been challenged on two main grounds. First, central banks' ability to spot financial imbalances might have been underestimated. In particular, new real-time indicators of costly asset-price booms and busts have recently been developed, based on historical correlations, and should perhaps be given their chance (see Borgy, Clerc and Renne, 2009, for a recent contribution). In any case, the central bank's degree of uncertainty about the size of possible financial imbalances may be of the same order of magnitude as its degree of uncertainty about, say, the size of the output gap. Given that central banks routinely estimate the latter to assess risks to price stability, why should they not estimate the former?

Second, the notion that the central bank should know more than the private sector about the 'fundamental price' on financial markets may not be a necessary condition for the desirability of a monetary policy response to perceived financial imbalances. Indeed, such a response might be desirable, even when this condition is not met, because of the existence of an externality that the private sector may fail to internalize. For instance, private banks' view on the existence of financial imbalances may be biased because of their gain from risk shifting, while central banks should at least have neutral incentives in identifying and reacting to financial imbalances. The central bank's intervention may also be desirable, even when it is less informed than the private sector, because it may stop an ex-ante welfare-detrimental herd behaviour on financial markets (see Loisel, Pommeret and Portier, 2009).

Concerning the effectiveness of monetary policy in leaning against the wind, it is commonly thought that having further but marginally tightened the monetary policy stance, say having set interest rates 1 percent higher than they actually were between 2002 and 2005, would have had little effects on investors (who levered their real estate investment to chase 10% per annum increases in real estate prices) and could have resulted in a significantly lower path for growth and inflation. Indeed, although the ineffectiveness of monetary policy in leaning against the wind has been questioned at the margin in the recent literature, [15] *the consensus remains today that some other policy tools, namely macro-prudential policy tools, should be much more effective in taming financial imbalances and less distortive for growth and inflation than policy interest rates.*

We describe such mechanisms in models that have been estimated over the period 1985-2010 for both the euro area and the US (see Appendix II for a description of the model). These estimates provide a first assessment of the circumstances under which the pursuit of price and financial stability may be conflicting. We focus in particular on the response of inflation to the typical shocks that have driven the business cycle on both side of the Atlantic over the last 25 years, as captured by our estimates.

We then consider whether alternative policy regimes influence influence dynamics under these "typical economic circumstances". We focus our analysis on four archetypical policy regimes:

i. A "plain vanilla" Taylor rule: this is the benchmark case where the monetary policy instrument, i.e. the short-term interest rate, follows a standard Taylor rule and is assigned the sole objective of price stability. According to this rule, the short-term nominal interest rate increases in reaction to both the inflation and the output gap.

ii. "Lean against the financial wind" or "augmented" Taylor rule: under this regime, monetary policy leans against financial winds, i.e. the Taylor rule is augmented with an argument whereby the short- term nominal interest rate increases with credit growth.

15 Several possible mechanisms by which a modest interest-rate hike might still affect financial imbalances have been described in the recent literature. In particular, this may occur because of the high degree of leverage of the private sector (Adrian and Shin, 200?), because the hike credibly signals the central bank's view on the fundamentals (Hoerova, Monnet and Temzelides, 2009), or because financial imbalances are due to a fragile informational cascade or herd behavior (Loisel, Pommeret and Portier, 2009).

iii. Independent macro-prudential policy: the two authorities conduct their policies separately and independently (i.e. non cooperatively), focusing on their respective objective.

iv. Finally, we consider a fourth policy regime in which the central bank factors in credit developments in its interest rate decision, that is, it follows an "augmented" Taylor rule, while an independent macro-prudential authority leans separately against the wind.

Box 2: Policy rules in the 4 regimes used for the simulations

	Monetary policy (Interest rate, Taylor type) rule				Macro Prudential Policy
	Lagged Interest rate	Inflation	GDP	Credit	
i Plain vanilla Taylor rule	0.75	1.50	0.50	0	none
ii Augmented Taylor rule	0.75	1.50	0.50	0.50	none
iii PTR + macro-prudential	0.75	1.50	0.50	0	0.50
vi ATR + macro-prudential	0.75	1.50	0.50	0.50	0.50

We assume that the purpose of macro-prudential policy consists mainly in "leaning against the financial winds."[16,17] Therefore, a macro-prudential rule involved in these third and fourth regimes specifies how a macro-prudential instrument leans against nominal credit growth. In our model, this takes the form of policy makers' ability to influence the loan-to-value ratio which enters the collateral constraint of impatient households and entrepreneurs. From a macroeconomic perspective, this is equivalent to limiting the amplitude of the deviation of aggregate credit from its steady-state value. It is indeed likely that the forthcoming macro-prudential policy could take the form of "leaning against credit", or implicitly lead to such an effect.[18] Such an outcome might result from the recourse to several instruments currently under discussion for macro-prudential policies. For instance, regulations requiring that banks set aside more capital as asset prices rise would raise the interest rate margin that banks have to charge on loans over their funding costs. Other instruments may contribute to this purpose, including dynamic provisioning, pro-cyclical capital or liquidity requirements, and taxation of credit or of maturity transformation. [19] We abstract from the discussion of the most appropriate instruments to lean against credit altogether, in order tofocus instead on the macroeconomic effects of such stabilisation policies.

3.2 A typology of shocks and their effects on price stability

There exists a broad consensus that policies aimed at price and financial stability ought to be mutually reinforcing following shocks that move aggregate demand, including credit supply shocks. On the other hand, the effects on inflation of these two objectives may be conflicting following shocks to productivity. [20] Indeed, a persistent increase in productivity can stimulate demand for houses because economic agents anticipate an increase in their future income and, provided some inertia of real wages, reduce both unit labour costs and inflation. To some extent, this corresponds to the situation of many OECD countries in the run up to the sub-prime crisis. Credit growth was very dynamic, growing much faster than GDP while inflation remained low and stable. Arguably, if inflation is indeed a monetary

[16] See footnote 1.

[17] Gertler, Kiyotaki and Queralto (2010) focus instead on the contrasting effects of subsidizing the issuance of external equity *ex ante*, which increases the resilience of the banking system in the event of the crisis, and the time varying threat of no public intervention in times of crisis, which increases risk-taking by the banking system as in Farhi and Tirole (2010).

[18] Alessi and Detken (2009) show that persistent deviations of the credit/GDP ratio from its trend (which is akin to our steady state level of credit) is a robust leading indicator of costly bust in the financial and the real cycles. See also Borgy, Clerc and Renne (2009) for a comprehensive analysis of early warning indicators of financial crises- led recessions.

[19] A presentation of these options is available in the CGFS report. See also Jeanne and Korinek (2010) on the pros and cons of a Pigouvian tax on credit.

[20] This point is also illustrated in Kannan, Rabanal and Scott (2009) and Angeloni and Faia (2010).

phenomenon, macro-prudential policies that would have slowed credit and money growth could have had the side effect of pushing inflation rates below the inflation objectives of monetary authorities, if not to negative values. Such policies could hence have put a threat on the anchoring of inflation expectations close to the level of the inflation objective of central banks.[21]

We use the estimated models in order to illustrate situations in which monetary and macro-prudential policies may either neutralize or reinforce each other. The behavioural parameters and the stochastic structure (i.e. the relative importance of shocks) are estimated over the period 1985-2010. We then compare the dynamics of economic variables across the four policy regimes listed above.

For this first simulation exercise we consider standard coefficients for the Taylor rule (see Box 2). The short-term nominal interest rate reacts with coefficient $\gamma_\pi = 1.5$ to the inflation gap and with coefficient $\gamma_y = 0.5$ to the output gap. In regime 2, the short-term nominal interest rate also increases by 0.5% for a 1% increase in the growth rate of nominal credit.

In regime 3 and 4 we also set, equally arbitrarily, the coefficient τ, capturing the strength with which authorities weight on credit growth by lowering the loan–to-value ratio, to 0.5. In regime 3 the monetary policy instrument is set following a standard Taylor rule, while in Regime 4 it is an augmented Taylor rule similar to the one introduced in regime 2.

Alternative policies within one type of regime differ in terms of the strength with which the policymaker reacts to inflation, the output gap or credit. These weights can be linked to the preferences of the authorities (see the textbooks of Woodford, 2003; Gali, 2008; and Walsh, 2010). We come back to this point later, but the main trust of the qualitative results we present here is not affected by the preferences implicitly consistent with these policy rule coefficients.

In view of the potential conflict between the objectives of price and financial stability under some circumstances, the next important question is to assess how important such shocks can be in the business cycle. This is however the object of an endless academic literature that goes beyond the scope of this paper.

A first pass on this question is to report how important such shocks were, according to our model estimates. The variance decomposition of inflation, output gap, short-term interest rate, credit and housing prices is reported in Table 3.1 (see Appendix IV. These estimates are based on the last 25 years of quarterly data for the euro area and the US.

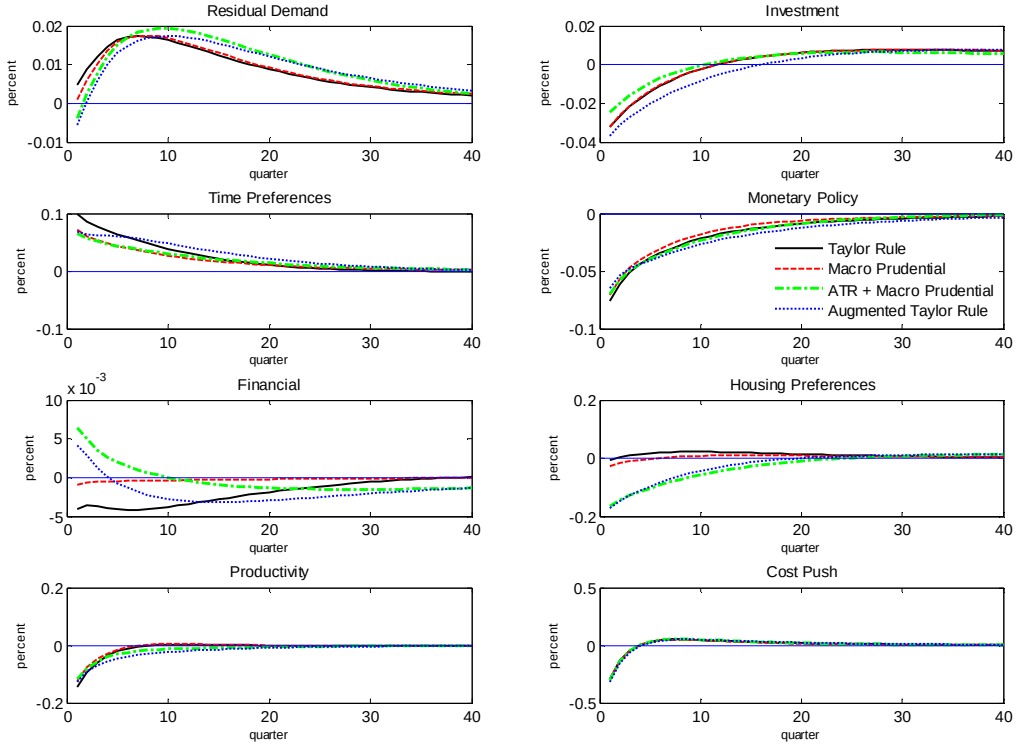
These variance decompositions point to those shocks that are the most important ones for the variance of inflation: mark up shocks for both countries, and to a lesser extent housing preference shocks, private demand shocks in the euro area, and, in the case of the US, productivity shocks.[22]

In any events, the most relevant point of our analysis is to describe whether the four policy regime imply differences in inflation dynamics. We find particularly striking that the response of inflation to the "structural shocks" of the model appears as very similar across the four policy regimes (Figure 3.1 a below for the euro area and 3.1b in Appendix IV for the United States). **With the exception of two shocks, namely the credit supply (or financial) shock and the housing preference shock, the response of inflation is almost identical across policy regimes.**

[21] On the trade- off between financial stabilization and the cost to the credibility of the inflation objective, see the illuminating discussion of Carney (2009).

[22] Several other results are worth underlining. First, investment-specific shocks dominate the variance of investment, consumption and GDP, while mark-up shocks dominate the variance of inflation in the two areas. Second, housing preference shocks dominate the variance of housing prices and of credit, while credit supply shocks impact only upon credit developments. This is a limit of the model which may fail to capture the quasi trend evolution of credit and its impact on demand. Third, there also some sharp differences across the areas. Productivity shocks are estimated to have a much larger effects on GDP and its components in the US than in the euro area.

Figure 3.1:Effects of Various Shocks on Inflation, ZE



The similarity is striking for the cost-push shocks, the productivity, the investment-specific technology, the residual demand, and the monetary policy shocks.[23] Interestingly, these five shocks, taken together, account for nearly 80% of the variance of euro area inflation, and for over 80 % in the US. **This similarity in the response of inflation across regimes**, which is consistent with the results obtained based on alternative models (e.g. Angelini, Neri and Panetta, 2010), **suggest that in most typical phases of the business cycle, an independent macro-prudential policy would not alter dramatically inflation dynamics**. It would therefore not interfere with the endeavour of monetary policy to maintain price stability.

Interestingly, the set of shocks for which the policy regime appears as largely irrelevant for the dynamics of inflation include both demand and supply shocks. For instance, as mentioned earlier, productivity shocks could introduce a conflict between price stability and financial stability because they draw goods and services prices and asset prices in opposite directions. However, in the model they also imply a persistent increase in the real interest rate. Inflation falls, but the inertia of the Taylor rule prevents the nominal interest rate to rise fast enough to overturn this increase. Credit demand falls in spite of the increase in house prices. Given our setting where authorities lean against credit (and not house prices), the policy regimes do imply different responses of inflation to productivity shocks.

There are some economic circumstances, however, when the effect on inflation differ across regimes. The most striking case is the housing preference shock. Inflation initially declines on impactbut its response is much larger and more persistent in the case of the augmented Taylor rule regime. This is because the increase in the real interest rate triggered by the reaction of the rate to credit growth weighs on the output gap and inflation. On the contrary, the output gap remains positive in regime 1 in which the simple Taylor rule is the sole active policy.

One of the most important results of our investigation is that inflation is most stable under regime 3, which combines a simple Taylor rule and macro-prudential policy. This is because the increase in house prices is prevented from translating into a credit boom, which would have otherwise stimulated demand and inflation.

[23] Figure 2.2 to 2.9 in annex IV report the effects of the shocks on other variables of the model for the euro area.

The other case in which we observe a different response of inflation across monetary policy regimes is the one of the credit supply shock[24]. By construction, the shock to credit is muted in regimes 3 and 4. And so are the output gap and inflation.

Altogether, **this qualitative exploration** of the circumstances that can lead to a conflict between monetary policy and macro-prudential policies **delivers two very clear conclusions**:

First, the policy regime is irrelevant for the dynamics of inflation for the shocks that are typically the dominant drivers of inflation.

Second, following shocks to asset prices (or preference for houses in the model) **and credit supply, the combination of an independent macro-prudential leaning against-credit policy and a monetary policy focused on inflation is the best for price stability**.

This is because such a macro-prudential policy can shield the business cycle from the perturbations originating within the financial sector.

3.3 Efficient combination of monetary and macro-prudential policies

The main purpose of the previous simulations was to identify the circumstances under which macro-prudential policies could interfere with the pursuit of price stability. While in that exercise we reported results from simulations based on policy functions which had *ad hoc* coefficients, in fact, we can approximate the most efficient policy within each regime and then compare such most efficient policies across regimes.[25]

This approach should reflect the preferences of the political body in charge of monetary and macro-prudential policies. given the uncertainty on the quantitative definition of financial stability, in what follows we exclusively focus on the preferences underlying the conduct of monetary policy. We assume that there are two objectives underlying the typical loss function of the central bank, an inflation-stabilization objective and an output-gap stabilization objective, and that monetary policy decisions aim at minimizing a loss function which admits, as its arguments, fluctuations in inflation, output, and the interest rate from their respective target values.

Against this background we run simulations in order to address the following two issues[26]:

- What is the quantitative role played by each policy in meeting each objective? To get a handle on this issue, we use simulations in order to assess how much is lost on each objective when either the monetary policy or the macro-prudential policy instrument is kept constant.

- What is the comparative effectiveness of each policy for the pursuing of each objective? In order to answer this question, we compare the impacts of a one-standard-deviation monetary policy shock to those of a one-standard-deviation macro-prudential policy shock on both the inflation rate and the output gap.[27]

---

[24] On average, over the last 25 years, this shock only accounts only for a small fraction of inflation's variance. Some shocks, however, can become very important at specific points in time, especially during times of (financial) crises.

[25] These comparisons are obviously model dependent. In the analysis of monetary policy rules, the success of the Taylor rule was precisely due to the fact that, across a variety of models, it performed nearly as well as model-specific optimal rules. <on this see the seminal paper by Levin, Wieland and Williams (2003).

[26] Whether the institutional arrangement of assigning the inflation-stabilization objective to monetary policy and the output-gap stabilization objective to macro-prudential policy comes close to the joint maximization, on the part of both policies of the overall objective function is an issue that we do not address in this paper -on this, see Angelini, Neri and Panetta (2010)).

[27] In the absence of any cost due to the variability of the policy instruments, the outcome of this comparison does not imply that, if each policy had to be assigned only one objective, then it should be assigned the objective for which it is relatively more effective. However, one can think (outside the model) of several reasons why, in practice, the variability of policy instruments may turnout to be costly (for instance the existence of the zero lower bound for nominal interest rates).

The simplest way to represent the design of efficient policies is to search for the policy parameters that minimise the loss function of the authorities in charge of monetary policy. We take such loss function to be the weighted sum of the standard deviations of the variable of interest:

$$Loss = \sigma_{\pi} + w_y \sigma_y + w_r \sigma_r$$

The largest the weights w_y and w_r , the more the monetary policy maker cares about output variability and interest rate volatility, respectively. In the case of the Federal Reserve, which has a double objective of full employment and price stability, we could for instance expect a higher weight w_y than for the Eurosystem, whose mandate is primarily to focus on price stability. In the later case we could in principle assume that $w_y = 0$. However, as argued by Svensson (1999), even the monetary policy of a central bank that seeks to stabilize inflation can be modeled *via* a Taylor rule which makes the policy rate react not only to the current (or expected) inflation rate, but also to the current (or expected) output gap, simply because the output gap is a determinant of future inflation

We do not want to take these exercises too literally because they crucially depend on model's parameters which, in general, are not precisely estimated. Our purpose is instead mainly illustrative.

We first compare the policy rule coefficients obtained for various weight structures in the authorities' preferences. We then report the associated volatilities for inflation, output, the interest rate and credit.

Table 3.2 below compares the optimal values of the policy rule parameters for the euro area conditional on two structures of preference weights (the results for the US are displayed in appendix IV, Table A.1). The first structure gives equal weights to the standard deviation of inflation, GDP and the interest rate in the loss function (rows 1 to 4), whereas the second gives weights of 1 to inflation and 0.05 to GDP (rows 7 to 10 for the euro area).[28] The latter structure of weights produces coefficients for the Taylor rule which are very close to the coefficients estimated for the period 1985-2010 (also reported in Table 3.2). This can be interpreted as reflecting the implicit preference of the ECB (and the Federal Reserve System), which put a much larger weight on inflation than on output fluctuations for the period 1985 2010. The two central banks differ however in terms of interest rate smoothing, which we estimate to have been twice as large in the US than in the euro area.

Some results of produced by the optimization procedure are strikingly similar across the Atlantic. First, when output and inflation volatility have weights of 0.05 and 1.0 in the authorities' loss function, the optimal coefficients on inflation are either somewhat larger than 1.5 in most cases for the euro area (column 2, row 7 to 10) or close to 2 in the US. Second, the strength of the interest rate reaction to credit growth is much smaller than the one we had assumed in the simulations reported in figures 3.1 to 3.9 in Appendix IV. Since, our main interest is the potential nuisance of *leaning against credit* for the traditional objectives of monetary policy, our loss function does not contain the objective of credit stabilization *per see*. As a result, variations in interest rates for credit stabilizations purposes have little impact on inflation and output stabilization while at the same time they increase the loss function through the higher volatility of the short-term interest rate.

Third, there are some benefits for inflation and output stabilization from raising τ closer to 1. As can be seen from figures 3.1 to 3.9 in Appendix IV, a coefficient of 0.5 already implies a sharp deviation of credit from its trajectory in Regimes 1 and 2, in neither of which can the authorities lean directly against credit.

The results produced by the optimization procedure can be assessed based on the gains produced in the variances of inflation, output, the interest rate and credit, as reported in Table 3.3 below. The loss function is always the smallest for regime 3, which offers the best mix in terms ofinflation, output and interest rate stabilisation. In the euro area it takes the value of 1.38 (2.07) against 1.54 (2.42) for the second best performing regime based on the first (or the second) structure of preferences. Hence **the**

[28] This calibration is roughly in line with results from the related literature (see Lippi and Neri, 2006). For the US, weights are 1 for inflation, 0.05 for GDP and 5 for the policy rate, close to the values found in Denis (2005).

existence of a macro-prudential policy objective appears to be largely beneficial to the pursuit of price stability on the part of monetary policy.

These results are not necessarily surprising. The third policy regime (combining standard monetary and macro-prudential policies) will necessarily dominate the second one (augmented monetary policy), which in turn will necessarily dominate the first one (monetary policy). Interestingly, however, it also dominates regime 4, which nevertheless nests regime 3 and the others. To some extent, this result is in line with Mundell's recommendation: if the policy-assignment principle[29] is not respected, this may lead to instability. Within the context of our exercise, violation of this principle leads to an increase in volatility for all of the variables relevant to the policy-maker. Does this result necessarily imply that coordination is unimportant in order to attain the best policy outcome?

Table 3.2: Estimated and optimized coefficients of the policy rules, euro area

		Interest rate	Inflation	GDP	Credit	Macro Prudential Policy
	Estimated Taylor rule coefficients (1985-2010)	0.82	1.72	0.43		
	Optimized coefficients (weights inflation, GDP, and interest variability =1)					
	Joint optimisation of all policy parameters in each regime					
1	Plain Taylor rule	0.32	1.63	1.33	-	-
2	Augmented Taylor rule	0.67	1.51	0.21	0.04	-
3	PTR + macro-prudential	0.31	1.63	1.35	-	0.74
4	ATR + macro-prudential	0.68	1.51	0.17	0.03	0.51
	Optimisation of Taylor rule coefficients for a given macro-prudential policy (tau=0,5)					
5	Plain Taylor rule	0.26	1.67	1.15		0.50
6	Augmented Taylor rule	0.68	1.51	0.17	0.03	0.50
	Optimized coefficients (weights on the variability of inflation= 1, GDP= 0.05 and interest rate= 2.5)					
	Joint optimisation of all policy parameters in each regime					
7	Plain Taylor rule	0.66	1.93	0.56	-	-
8	Augmented Taylor rule	0.70	1.50	0.13	0.01	-
9	PTR + macro-prudential	0.87	1.65	0.43	-	0.61
10	ATR + macro-prudential	0.70	1.50	0.13	0.00	0.50
	Optimisation of Taylor rule coefficients for a given macro-prudential policy (tau=0,5)					
11	Plain Taylor rule	0.86	1.63	0.40		0.50
12	Augmented Taylor rule	0.73	1.50	0.13	0.00	0.50

Note: the table present 2 panels: Rows 1 to 6 for a loss function assigning equal weights to the standard deviation of inflation, GDP growth and the interest rate; Rows 7 to 12 for a loss function assigning weights of 1, 0.05 and 2.5, respectively to the standard deviation of inflation, GDP growth and the interest rate. Within each panel, rows 1 to 4 and 7 to 10 show comparisons with the efficient policy rule based on the joint minimisation of the loss function across all available instruments within a given regime. Rows 5 and 6, and 11 and 12, report the coefficients of the efficient Taylor rules taking the intensity of the macro-prudential policy rule as given.

[29] According to which "policies should be paired with the objectives on which they have the most influence."

3.4 Efficient monetary policy for a given macro-prudential policy stance

We now consider a situation in which the central bank minimises its loss function for a given macro-prudential policy stance. This is in order to consider the situation in which the central bank is not associated to the decision-making process and/or to the implementation of macro-prudential policies, which are set and implemented independently and separately. The central bank, nevertheless, takes into account macro-prudential policies in the formulation of its own policy.

The results from this exercice are presented in rows 5 and 6 and 11 and 12 in Table 3.2 for the efficient policy rules coefficients, and in Table 3.3 for the associated outcomes in terms of stabilisation. The results suggest that, for the purposes of inflation and interest rate stabilization, it might be more efficient to optimize the Taylor rule coefficients taking the macro-prudential policy as given. For instance, the losses are the smallest in these simulations scenarios for both structure of preferences in the euro area and for the second structure of preference weights (rows 7 to 10 in Table A.2 in Appendix IV) in the US.

Altogether, **the independent pursuit of financial stability on the part of a macro-prudential authority which is independent from the central bank does not necessarily introduce hurdles in the pursuit of price stability** on the part of the central bank. This depends on the structure of the economy, on the extent of spill over between the two policies and the preferences of the policy maker. In the case in which the central bank has a pronounced preference for inflation stabilisation over output stabilisation, the best achievable outcome is obtained when the central bank uses the efficient coefficients for the standard Taylor rule, taking the credit stabilisation policy as given.

Table 3.3: Standard deviations and the loss function across regimes, euro area

		GDP	CPI	TX	Loss 1	Loss 2	Credit
	Stabilization effects of optimized policies (weights inflation, GDP, smoothing =1)						
1	Plain Taylor rule	0.20	0.49	0.96	1.65	-	0.75
2	Augmented Taylor rule	0.65	0.28	0.61	1.54	-	0.73
3	PTR + macro-prudential	0.17	0.39	0.82	1.38	-	0.44
4	ATR + macro-prudential	0.53	0.52	0.79	1.83	-	0.41
	Stabilization effects of optimized policies (constrained by given macro-prudential policy, above weights)						
5	Plain Taylor rule	0.19	0.36	0.78	1.33	-	0.56
6	Augmented Taylor rule	0.53	0.52	0.79	1.83	-	0.41
	Stabilization effects of optimized policies (weights inflation 1, GDP 0.05, smoothing 2.5)						
7	Plain Taylor rule	0.40	0.54	0.92	-	2.86	0.74
8	Augmented Taylor rule	0.82	0.54	0.82	-	2.63	0.72
9	PTR + macro-prudential	0.51	0.42	0.65	-	2.07	0.35
10	ATR + macro-prudential	0.59	0.50	0.75	-	2.42	0.41
	Stabilization effects of optimized policies (constrained by given macro-prudential policy, above weights)						
11	Plain Taylor rule	0.52	0.22	0.40	-	1.26	0.41
12	Augmented Taylor rule	0.60	0.49	0.74	-	2.37	0.41

Note: the table shows2 panels: Rows 1 to 6 for a loss function assigning equal weights to the standard deviations of inflation, GDP growth and the interest rate. Rows 7 to 12 for a loss function assigning weights of 1, 0.05 and 2.5, respectively, to the standard deviations of inflation, GDP growth and the interest rate. Within each panel, rows 1 to 4 and 7 to 10 show comparisons with the efficient policy rule based on the joint minimisation of the loss function across all instruments within a given regime. Rows 5 and 6 and 11 and 12 report the coefficients of the efficient Taylor rules, taking the intensity of the macro-prudential policy rule as given. Loss 1 is the sum of the first three columns for rows 1 to 6 (equal weights in the loss function), while loss 2 is a weighted sum of the first three columns with weights 0.05 on the standard deviation of GDP growth, 1 on the standard deviation of inflation and 2.5 on the standard deviation of the interest rate, reflecting the weights of the loss function.

4. Institutional implications for central banks

Three main conclusions can be drawn from the outcomes of the simulations presented in section 3.

First, under most circumstances, i.e. following shocks which explain the lion's share of inflation variance, inflation dynamic is not affected by the existence of a macro-prudential policy. Moreover, in the case of credit supply or asset price shocks, for which macro-prudential policy makes indeed a difference for inflation, such policy tends to actually stabilize inflation, because it shields the economy from these disturbances.

Second, our experiment partly mimics the behaviour of a central planner who could decide jointly on the strength of the coefficients in the policy rules for both the short-term interest rate and lean against-credit instruments. In that case, the most efficient policy regime to stabilise inflation (and output) is one in which monetary policy follows a simple Taylor rule, while adding a macro-prudential policy would improve upon such outcome. By contrast, using the short-term interest rate in order to lean against credit turns out to be destabilising for both inflation and output.

Third, the best scenario for the stabilisation of inflation (and output) is the one in which the central bank can choose its policy rule coefficients by taking into account of the strength of the lean against-credit policy. Put another way, in order to deliver the most efficient monetary policy outcome the central banker must be fully informed of the policy implemented by the macro-prudential authority. Within a context in which macro-prudential policy might be partly discretionary, information-sharing is therefore of paramount importance.

Although these results are relatively intuitive, we need to stress upfront that they have been derived based on a rather restrictive representation of policy decisions. The second and third results, indeed, consider situations in which policy-makers choose specific policy rules and stick to them forever. Policy-making in the real world, however, cannot and should not be reduced to such "automatic policies." Policy-makers should indeed be allowed to exert discretion, because of all the unforeseen contingencies that might occur, given that the model does not provide a comprehensive representation of the economy, and that even the economic relationships represented in the model may change over time. In our discussion of the most desirable institutional setup for macro-prudential policies, It is important to keep in mind these considerations in view of their impact on the objectives of monetary policy.

These three main results tend to suggest the desirability of institutional arrangements that relying on the separate-assignment approach to formulating monetary and macro-prudential policy. However, they also imply that coordination is necessary.

In the next section, we assess the extent to which the new institutional arrangements chosen or proposed by the US, the UK and the European Union may facilitate such coordination between responsible authorities.

4.1 Coordination within the new institutional arrangements

Box 2 below presents the main features of the new institutional arrangements recently adopted in Europe or currently debated in the US and in the UK. While the three setups are somewhat different in nature, it must be noted that each of them has been designed so as to allow an effective coordination and information-sharing amongst the central banks and the authority in charge of the macro-prudential policy.

Box 2: institutional arrangements in the US the UK and the EU

The responses to the crisis in terms of macro-prudential regulation have been quite heterogeneous a lot across different jurisdictions. On the one hand, the Financial Regulation Bill –(also referred to as the Dodd-Frank Act)-, which was approved by the U.S. Senate in July 2010, has created a new Financial Stability Oversight Council (FSOC), headed by the Treasury Secretary and independent from the Fed. On the other hand, the UK Treasury presented, in July 2010, a proposal for reforming the tripartite model, which will create a new Financial Policy Committee within the Bank of England with primary statutory responsibility for maintaining financial stability. In Europe, following the recommendations of the de Larosière report, the European Commission has created a European Systemic Risk Board (ESRB), which came into force on December 16, 2010 and which, like its US counterpart, is independent from the European Central Bank. By contrast to its US counterpart, however, the ESRB is not provided with the full control of macro-prudential tools.

In the US, the Dodd-Frank Act and the Consumer Protection Act adopted last summer are probably the most extensive pieces of financial services regulation since the Great Depression. The Dodd-Frank Act creates a new interagency council, the Financial Stability Oversight Council (FSOC), but also establishes a new system for the liquidation of certain financial companies; it provides for a new framework to regulate derivatives; it establishes new corporate governance requirements; and it regulates credit rating agencies and securitization. The FSOC will be in charge of identifying, monitoring and addressing systemic risks posed by large and complex financial firms, and of making recommendations to regulators. It will also be tasked with monitoring domestic and international regulatory proposals, facilitating information-sharing among financial services regulators, designating non-bank financial companies as systemically important, and providing recommendations to the Federal Reserve Board on prudential standards. It will be able to provide direction to, and request data and analyses from, the Office of Financial Research (OFR). Being within the Treasury Department, this Office will contribute to improving the quality of financial data available to policy-makers and providing analytical support to the FSOC. It should also develop a reference database easily accessible to the public, in order to maximise data efficiency and security, by coordinating with regulators, both domestically and internationally. Finally, it should standardise financial reporting requirements.

In performing its tasks, the FSOC will therefore be completely independent from the Fed. Interestingly, in addition to its current oversight responsibilities, and in order to mitigate risks to the financial system from large, interconnected financial institutions, the Fed will be directed to establish prudential standards of its own or at the FSOC's recommendations. That is, the Fed is entrusted with autonomous macro-prudential tools on top of its dual monetary policy mandate.

In the UK, recognizing serious failures in their tripartite regulatory system, the UK authorities took a major step in order to change their regulatory framework, transferring operational responsibility for prudential regulation from the FSA to a new subsidiary of the Bank of England. In addition, a new Financial Policy committee will be created within the Bank of England with the responsibility for maintaining financial stability. This committee will work internationally with similar systemically-focused authorities and with the ESRB to coordinate macro-prudential policies. The aim of this reform is to bring together responsibility for macro and micro-prudential regulation within a single institution, i.e. the central bank.

To some extent, the European way is intermediate between the US and the UK approaches. Like in the US, the ESRB is an interagency council, independent from the ECB and only focused on macro-prudential policy. On the other hand, the inception of the ERSB is drawing heavily from the knowledge and the experience of the Eurosystem. Additionally, the ECB will provide the ESRB with analytical, statistical, administrative and logistical support. National central banks and supervisors will also provide technical advice, which will constitute an important input into the work of the ESRB.

A major difference with the US and the UK is however the lack of effective and autonomous regulatory tools. In effect, the ESRB will only have the possibility to issue warnings and recommendations. The institutional arrangement, which will bring together from January 2011 central bank governors and heads of supervision, should ensure both effective coordination and information-sharing. The ESRB will be tasked with identifying and measuring systemic risk. It has been mandated to develop a "risk dashboard", prioritize these risks, conduct top-down stress tests when appropriate, and, finally, propose policy responses through warnings and recommendations. These however will not designate individual financial institutions.

These tools will be based on the obligation to "comply-or-explain". Therefore, even though the ESRB will have no formal directive power and the comply-or-explain obligation would not be legally binding, such recommendations should have considerable moral force. The effectiveness of these recommendations may be considerably strengthened if they are made public.

In the US, the Financial Stability Oversight Council (FSOC) will be independent from the Fed and will be chaired by the US Treasury. The Fed will however participate, jointly with other regulators, in the FSOC and will support the Council's mission to prevent and address risks to financial stability. Such an involvement makes sure that the threats, and the efforts to mitigate systemic financial risk will effectively inform the conduct of monetary policy. It should however be noted that the Fed will be directed to establish prudential standards of its own and that it is entrusted with autonomous macro-prudential tools on top of its dual monetary policy mandate. Using the insights from our simulation exercises, care should therefore be taken to limit the risk of implementing redundant macro-prudential policies, thus generating unintended volatility in key macroeconomic variables.

In Europe, the European Systemic Risk Board is distinct and separate from the ECB. It will neither change the monetary policy mandate, nor the functioning of the ECB nor that of any national central bank in the EU. However, the ECB will play a pivotal role in the new framework. The presence of the governors of all EU central banks in the Board of the ESRB, and the appointment of the ECB's President as the Chair of the ESRB, assign a pivotal role to the authorities in charge of monetary policy in the support of the ESRB. The joint participation of central banks both in the ECB's governing council and the ESRB Board should greatly facilitate coordination and the exchange of information between the two institutions.

Finally, in the UK, the new Financial Stability Committee will be created within the Bank of England. It will be separate from the Monetary Policy Committee and will have an overall membership of 11, including internal members from the Bank of England. The remaining five members will be from outside the Bank, including a Treasury representative. This new committee will be chaired by the Governor and will include the Deputy Governors in charge for monetary policy and financial stability and the newly created Deputy Governor for prudential regulation. Here, once again, the framework insures that the monetary policy decisions will effectively be fully aware of the macro-prudential policy design and implementation. Coordination will be facilitated by having the Governor of the Bank chairing both the financial and the monetary policy committees.The reform acknowledges that a significant challenge for the Bank will precisely be to manage this interaction between two statutory objectives and already made some proposals to do so. Under this respect, an important proposal is the sequencing of the meetings in order to make sure both committees will be able to fully take into account the most recent decisions taken by the others.

An important aspect of the coordination process relies of the information flows and sharing between the responsible institutions or committees. The US authorities indeed established a specific institution, the OFR (see Box 2 above) to cope with this issue. Information sharing between the monetary and macro-prudential authorities is in that context of paramount importance. Considerations of data availability place central banks in an ideal position as key information providers in the field of macro-prudential policies due to the enormous amount of data they already collect for the conduct of monetary policy.. At the same time, we showed in section 3 that efficient policy outcomes can be attained provided that the central bank knows the reaction function of the macro-prudential authority.

Therefore, in order to achieve an efficient outcome, the central bank must factor into its own decision making the macroeconomic effects resulting from macro-prudential policies. This also implies that the timing of the meetings of the committees or boards in charge of these the two policies ought to be set to facilitate this effective information-sharing and policy coordination.

4.2 Remaining challenges

The dilution of responsibilities amongst authorities, and the associate risk of "territorial" disputes, can be addressed, or at least limited, by a clear assignment of objectives and tools. As a matter of fact, the simulations presented in section 3 clearly suggest that the conduct of monetary policy should keep a primary objective of maintaining price stability. Hence, the macro prudential policy should not rely on monetary policy to preserve financial stability.

Ideally, the design of the macro-prudential policy objectives should preserve the independence of monetary policy making, facilitate coordination between the two policies, limit conflicts of objectives and clarify how these can be resolved when they occur.

First, the new macro-prudential objectives should be fully compatible with the monetary policy mandate in the following sense. It should neither jeopardize the primary objective of price stability for monetary policy nor put the central bank's independence in their pursuit price stability at risk[30]. That inflation expectations remained firmly anchored throughout the most severe financial crisis in 80 years has proven to be a considerable asset in the management of crisis. This asset, which builds on the clear mandate of monetary policy, the operational independence of central banks and their track record, should not be put at risk. In addition, the interferences with the conduct and the implementation of monetary policy should be limited to the maximum possible extent.

Second, clarity about the objectives of macro-prudential policies should be provided *ex ante*. The current proposals tend to favour institutional setups involving several institutions or layers. This would imply close coordination between entities in charge of micro and macro prudential regulations on the one hand, and between macro-prudential policies and other macroeconomic policies – monetary and fiscal policies in particular- on the other. Therefore, clear objectives would minimize the potential for macro-prudential policies to undermine the responsibility for the objectives relevant to micro-prudential supervision, fiscal and monetary policies. The extent and the nature of the collaboration amongst the various agencies involved in macro-prudential regulation in the financial crisis management phase are primarily shaped by how the different responsibilities for supervision and regulation, bank resolution, the provision of public guarantee and solvency support are allocated.

Finally, in circumstances where monetary policy and macro-prudential policy objectives may be temporarily in conflict, accountability requires that such a conflict is publicly acknowledged. Policy bodies should be transparent on the extent to which how policy decisions factor in trade-off between objectives. The common objective should be to strike the right balance between the short-term costs of financial stability and long-term costs of price instability (e.g. as explained in Carney, 2009, the de-anchoring of inflation expectations).

In practise however, it should be stressed that an accountability framework of macro-prudential authorities will be more difficult to design than the one for monetary policy authorities. To begin with, as of today, we have neither a quantitative, nor (some may even say) a qualitative, definition of financial stability nor can we rely on an operational definition of systemic risk. This is in sharp contrast with the widely agreed definition and measurement of price stability on the basis of consumer price indices.

[30] We refer here to the situation of Europe. In the case of the US, the Fed's monetary policy has a dual mandate of price stability and full employment.

Recent research has been developing measures of systemic risk and means to allocating such risk to financial institutions (see for instance Engle and Brownlees, 2010). However, the construction of financial stability indices (see Hollo et al., 2010) is still in its infancy. Moreover, the goal of this research is rather to provide new indicators than operational or quantitative targets to be assigned to macro-prudential authorities.

The parallel with the monetary policy framework, as it has been designed over the last two decades, although tempting, is still very remote as far as macro-prudential policy is concerned.

5. Conclusion

In this paper, we analyse the interactions how macro-prudential policy may affect the conduct the performance of monetary policy.

We assess whether macro-prudential and monetary policies may have compounding, neutral or conflicting effects on financial and price stability. According to an econometric approach relying on a DSGE model estimated for both for the euro area and the US, we show that episodes of conflict should be rather limited, on average, over the business cycle. These conflicts depend on the nature of the shocks impacting on the economy. Over the period under review (1985-2009), both the credit and the housing preference shocks, which are the most relevant for macro-prudential policies, only marginally accounted for inflation dynamics, on average. Assuming that such a finding is robust across different sample periods, this means that the implementation of macro-prudential policy should not be overly harmful to monetary policy. Quite on the contrary, it may even facilitate the latter by offsetting the transmission of financial disturbances to the real economy. This assumes however that the macro-prudential authority is able to counter the propagation of destabilizing asset price and credit supply shocks to the real economy by leaning against credit.

Our findings suggest that the best policy outcomes are attained when monetary and macro-prudential policies are carried out separately and independently. However, such results assume that, in setting efficiently its key interest rate, the central bank takes as given the macro-prudential policy. This means that the separate-assignment principle should not be taken too literally. Both monetary and macro-prudential policies need to factor in the macroeconomic effects of other policies. This is particularly true when spill-overs between policies occur.

Institutional arrangements should be designed in order to facilitate the coordination and the efficient information-sharing amongst institutions. So far, current proposals tend to address the main challenges related to these issues, though in somewhat different frameworks. Using the insights from our simulation results, we point out some of the remaining challenges: in the US, these are related to the risk of violating the policy-assignment principle by having the Fed conducting eventually redundant macro-prudential policies with the FSOC. Similar concerns exist in the UK where both the objectives and the frontiers between the two decision bodies within the Bank of England would have to prove sufficiently clear. Turning to Europe, both the decision making process and the effectiveness of the warnings and recommendations issued by the ESRB have to prove efficient and timely. Finally, we need better concepts and measurement of the desirable objectives of macro-prudential policies.

References

Alessi L. and Detken C. (2009): "Real Time Early Warning Indicators for Costly Asset Price Boom-Bust Cycles", *ECB Working Paper n. 1039.*

Angelini, P., Neri, S., Panetta, F. (2010): "Grafting macroprudential policies in a macroeconomic framework, choice of optimal instruments and interaction with monetary policy", *mimeo, Bank of Italy*.

Angeloni I. and Faia E. (2009): "Tale of Two Policies: Prudential Regulation and Monetary Policy with Fragile Banks", *Kiel Working Papers 1569.*

Antipa P., Mengus E. and Mojon B. (2011): "Would Macro-prudential Policies Have Prevented the Great Recession?", *Banque de France mimeo*.

Altunbas Y. Gambacorta L. and Marqués-Ibáñez D. (2010): "Does Monetary Policy Affect Bank Risk-Taking?", *ECB Working Paper n. 1166, March 2010.*

Basel Committee on Banking Supervision (2009a): "Strengthening the resilience of the banking sector", *consultative document, Basel.*

Basel Committee on Banking Supervision (2009b): "International framework for liquidity risk measurement, standards and monitoring", *consultative document, Basel.*

Basel Committee on Banking Supervision (BCBS) (2010a): "Countercyclical capital buffer proposal", *Note from the Macro Variables Task Force to the Basel Committee, February.*

Bean C. (2003): "Asset Prices, Financial Imbalances and Monetary Policy: Are Inflation Targets Enough?", *BIS Working Paper No. 140.*

Bernanke B. and Gertler M. (1999): "Monetary policy and asset price volatility," *Economic Review, Federal Reserve Bank of Kansas City, issue Q IV, pages 17-51.*

Bernanke B., Gertler M., Gilchrist S. (1999): "The financial accelerator in a quantitative business cycle framework" In: Taylor, J.B., Woodford, M. (Eds.), *Handbook of Macroeconomics, Elsevier Science, Amsterdam.*

Borgy V. Clerc L.and Renne J.-P. (2009): "Asset-price boom-bust cycles and credit: what is the scope of macro-prudential regulation?", *Banque de France Working Paper No. 263.*

Borio C. (2010): "Implementing a macro-prudential framework: blending boldness and realism", *Speech, HKMR-BIS conference, July.*

Borio C. and Lowe P. (2002): "Asset Prices, Financial and Monetary Stability: Exploring the Nexus", *BIS Working Paper No. 114.*

Borio C. and Zhu H. (2008): "Capital Regulation, Risk-Taking, and Monetary Policy: A Missing Link in the Transmission Mechanism?", *BIS Working Paper n. 2588, December 2008.*

Borio C. and Drehmann M. (2009): "Towards an operational framework for financial stability", *BIS Working Paper # 292.*

Brownlees C., Engle R. (2010): "Volatility, Correlation and Tails for Systemic Risk Measurment", *WP NYU-Stern.*

Carney M. (2009): "Some considerations on using monetary policy to stabilize economic activity", *Remarks by Mr Mark Carney, Governor of the Bank of Canada, to a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 22 August.*

Canzoneri M. B., and Henderson D. W. (1991): "Monetary policy in interdependent economies: A game theoretic approach", *the MIT Press.*

Carlstrom C.T., Fuerst T.S. (1997): "Agency costs, net worth, and business fluctuations: a computable general equilibrium analysis", *The American Economic Review 87, 893–910.*

Cecchetti S., Genberg H., Lipsky J.,Wadhwani S. (2000): "Asset Prices and Central Bank Policy", *Geneva Reports on the World Economy 2 (Geneva: International Centre for Monetary and Banking Studies).*

Cecchetti S. and Kohler M. (2010): "On the equivalence of capital adequacy and monetary policy", *BIS mimeo.*

Christiano L., Ilut C., Motto R., Rostagno M. (2010): "Monetary Policy and Stock Market Booms", *Jackson hole paper.*

Christiano L., Motto R. and Rostagno M. (2007): "Shocks, structures or monetary policies? The euro area and US after 2001", *ECB Working Paper*

Ciccarelli Matteo., Maddaloni A., and Peydró J-L. (2009): "Trusting the Bankers: Another Look at the Credit Channel of Monetary Policy", *ECB, mimeo*

Committee on the Global Financial System (2010): "Macro-prudential instruments and frameworks: a stock taking of issues and experiences", *CGFS Papers No 38, May.*

De Graeve F. (2008): "The External Finance Premium and the Macroeconomy: U.S. post-WW II Evidence", *Journal of Economic Dynamics and Control, vol. 32(11).*

De Nicolo G., Dell Ariccia G., Laeven L., Valencia F. (2010): "Monetary policy and bank risk taking" *IMF staff position note, July*

Dib A. (2009): "Banks, Credit Market Frictions, and Business Cycles", *Bank of Canada Document de travail 2010-24*

Dubecq S., Mojon B. and Ragot X. (2010): "Fuzzy Capital Requirements, Risk Shifting and the Risk Taking Channel of Monetary Policy", *Banque de France NER 254.*

Fahr S., Rostagno M., Smets F. and Tristani O. (2010): "A Monetary Policy Strategy in Good and Bad Times", *ECB Working Paper.*

Faia E., Monacelli T. (2007): "Optimal Interest Rate Rules, Asset Prices and Credit Frictions", *Journal of Economic Dynamics and Control.*

Gerali A., Neri S., Sessa L., Signoretti F. (2009): "Credit and banking in a DSGE model of the Euro Area", *mimeo, Bank of Italy.*

Gilchrist S., Ortiz A., Zakrajsek E. (2009): "Credit Risk and the Macroeconomy: Evidence from an Estimated DSGE Model", *Federal Reserve Board, mimeo*.

Greenspan A. (2002): "Economic Volatility" *Remarks by Chairman Alan Greenspan at a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming August 30, 2002*

Goodhart C. and Hofmann B. (2002): "Asset Prices and the Conduct of Monetary Policy", *Proceedings of the Royal Economic Society Annual Conference 2002*.

Hoerova M., Monnet C. and Temzelides T. (2009): "Money talks", Working Paper 1091, European Central Bank.

Hollo D, Kremer M. and Lo Duca M. (2010): "CISS – A composite indicator of systemic stress in the financial system," *ECB working paper, November*.

Holmstrom B., Tirole J. (1997): "Financial intermediation, loanable funds, and the real sector", Q*uartely Journal of Economics 112, 663–691*.

Iacoviello M. (2005): "House prices, borrowing constraints, and monetary policy in the business Cycle", *The American Economic Review 95, 739–764*.

Kannan, P., Rabanal P. and Scott A. (2009): "Monetary and Macroprudential Policy Rules in a Model with House Price Booms", *IMF working paper no. 251*.

Kashyap A. and Stein J. (2010): "The Optimal Conduct of Monetary Policy with Interest Rate on Reserves", *NBER WP, December*.

Kishan R. and Opiela T. (2006): "Bank capital and loan asymmetry in the transmission of monetary policy", *Journal of Banking and Finance, 30, pp. 259-285.*

Kiyotaki N., Moore J. (1997): "Credit cycles", *Journal of Political Economy 105, 211–248*.

Liu Z., Wang P., Zha T. (2009): "Do credit constraints amplify macroeconomic fluctuations?" *mimeo.*

Loisel O., Pommeret A. and Portier F. (2009): "Monetary policy and herd behaviour in new-tech investment", *mimeo Banque de France.*

Meh C., Moran K. (2010): "The role of bank capital in the propagation of shocks", *Journal of Economic Dynamics and Control.*

Modigliani F. and Miller M. (1958): "The cost of capital, corporation finance and the theory of investment", *The American Economic Review, Vol. 48, Nº 3.*

Mundell R. (1962): "The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability", *IMF Staff papers, March, pp. 70-73.*

Ongena S., Peydró J-L., Vasso I. (2008): "Monetary Policy, Risk-Taking and Pricing: Evidence from a Quasi-Natural Experiment", *ECB, mimeo.*

Rajan R. (2005): "Has Financial Development Made the World Riskier?", presented at: *The Greenspan Era: Lessons for the Future, a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 25 - 27, 2005.*

Svensson L. (1999): "Inflation targeting as a monetary policy rule", *Journal of Monetary Economics,*

vol. 43, pp. 607-654.

Townsend R. (1979): “Optimal contracts and competitive markets with costly state verification” *Journal of Economic Theory vol. 21(2)*

de Walque G., Pierrard O. and Rouabah A. (2008): "Financial (in)stability, supervision and liquidity injections : a dynamic general equilibrium approach," *Research series 200810-23, National Bank of Belgium.*

APPENDIX I

Literature review: financial frictions and canonical macro-models

Canonical macroeconomic models mostly incorporate the assumption of frictionless financial markets. Based on the Modigliani-Miller (1958) theorem, these models imply that the composition of agents' balance sheets has no effect on their optimal spending decision. Thus, canonical macro models have difficulties accounting for the feedbacks between financial conditions and the real economy in times of financial distress.

One of the first contributions to have challenged the Modigliani-Miller theorem is the seminal article by Bernanke, Gertler and Gilchrist (1999, B.G.G. henceforth). In this framework, borrowers face an external finance premium, which reflects the different costs of internally and externally raised funds. The finance premium inversely depends on borrowers' net worth, which is pro-cyclical due to the pro-cyclicality of profits and asset prices. This entails that the external finance premium is countercyclical, enhancing the swings in borrowing and hence investment and aggregate demand. The external finance premium therefore propagates shocks to the real economy and amplifies business cycle fluctuations.

Gilchrist, et al., (2009) incorporate a proxy of the external finance premium in a DSGE model estimated on US data over the period 1973-2008. The authors find an operative financial accelerator, i.e. increases in the external finance premium cause important and protracted contractions in investment an output. De Graeve (2008) provides for an estimate of the external finance premium, which is on average of 130 basis points over the post-WWII period[31].

Another type of framework focusing on borrowers' balance-sheets goes back to the work of Kiyotaki and Moore (1997). In this set-up, lenders cannot force borrowers to reimburse their debt. Thus, durable assets such as land and machinery play a dual role, being used as factors of production and collateral for loans at the same time. Borrowers' credit lines are consequently affected by the collateralized assets' prices and collateral constraints govern borrowers' investment and spending decisions, which in turn then again affect asset prices. The dynamic interaction between credit limits and asset prices function as transmission mechanism by which the effects of financial shocks persist, are amplified and spill over to other sectors.

Liu, Wang and Zha (2010) estimate a DSGE model with US data and show that the amplification mechanism in Kiyotaki and Moore (1997) is empirically important. This study finds positive co-movements between housing prices and business investment. A shock to housing demand –affecting the marginal rate of substitution between housing and consumption– generates important macroeconomic fluctuations, accounting for 36 - 46% and 22 - 38% of the fluctuations in investment and output respectively.

One implication of the above described models is that borrowing constraints are always binding, in which case default never occurs in equilibrium. In contrast, in Carlstrom and Fuerst's (1997) analysis[32], agency costs are endogenous over the business cycle and default emerges as an equilibrium phenomenon. Consequently, there is room for regulatory policies. Based on this framework, Faia and Monacelli (2007)[33] address the question of whether monetary policy should react to asset prices, answering it by the affirmative. More precisely, in their setting asset price movements are caused by financial distortions, since the price of capital is determined in a lending market characterized by moral hazard, i.e. the asset price is subject to a tax. In the case of a positive productivity shock, this wedge evolves pro-cyclically, thereby restraining investment. For an increase in asset price, monetary policy should therefore react by lowering the nominal interest rate. This result may seem controversial; it hinges, however, also on the metric that is used to evaluate the performance of

[31] When taking the model to the data, the author finds that for some shocks (such as investment supply shocks) the finance premium is not countercyclical. This may give rise to a financial decelerator mechanism corroborated also by the results of Iacoviello (2005) and Christiano, Motto and Rostagno (2007, see further below for more details).

[32] Based on the costly state verification model by Townsend (1979)

[33] The authors succeed in generating a countercyclical behavior of the external finance premium by assuming that the mean distribution of investment outcomes across lenders depends on the state of aggregate productivity: the pro-cyclicality of the external finance premium in Carlstrom and Fuerst initial analysis being a very counterintuitive result.

different policy rules. While usually policy rules are assessed considering the volatility of inflation and output, here the selection is based on strict welfare criteria.

In a recent paper, Iacoviello (2005) combines a financial accelerator mechanism à la BGG with collateral constraints tied to real estate values in the spirit of Kiyotaki and Moore (1997). A third rigidity is added to this framework, debt contracts are denominated in nominal terms. This allows considering the distributional consequences of nominal rigidities as in Fisher (1933). The Fisher debt deflation channel amplifies effects of shocks that drive output and the price level in the same direction, such as positive demand shocks[34], and dampens the impact of shocks that drive output and the price level in opposite directions. Finally, Iacoviello finds that responding to asset prices does not improve output and inflation stabilization.

The above mentioned studies consider the demand side of financial frictions, i.e. borrowers' balance sheets. Arguably supply side factors, may have an substantial impact on the business cycle; that is to say that banks' balance sheet might affect the transmission of shocks. Christiano *et al*. (2007) incorporate a banking sector into a DSGE model containing also a debt-deflation channel. As in Iacoviello, the authors find that financial accelerator/decelerator mechanisms depending on the nature of shocks. Moreover, quantitatively, financial frictions à la B.G.G. are an important driving force of business cycle fluctuations, both in the euro area and the US. When it comes to the transmission and amplification of shocks these frictions play a substantially bigger role than the incorporated banking sector. Finally, in this set-up, output volatility is stabilized when broad monetary aggregates are taken into account; reacting to the stock market is stabilizing for the US economy but not so for the euro area.

Meh and Moran (2010) construct a dynamic general equilibrium model in which the balance sheet of banks affects the propagation of shocks[35]. Key to the propagation of shocks in this model is the banks' capital adequacy ratio. Although it arises from market discipline, the simulations give insights on its cyclical properties: whether capital adequacy ratios ought to be pro-cyclical or will depend on the nature of shocks. Following technology and monetary policy shocks capital adequacy ratios vary negatively with the cycle, possibly exacerbating the business cycle. When disturbances originate within the banking sector (i.e. sudden drops in bank capital) capital adequacy ratios are pro-cyclical: capital adequacy ratios loosen just as output weakens. Finally, independent of the shock's nature, economies whose banking sectors remain well-capitalized experience smaller reductions in bank lending and hence less severe downturns. Bank capital thus increases an economy's ability to absorb shocks and, in doing so, affects the conduct of monetary policy.

Finally, de Walque *et al*. (2008) model an interbank market, populated by heterogeneous banks. In their framework, agents, including banks, can default on their financial obligations. Here, endogenous default rates generate a countercyclical risk premiums acting as a financial accelerator. Their framework is particularly interesting, since monetary policy takes the form of liquidity injections into the interbank market. The authors find that a central bank's liquidity injections lead to less financial instability (measured by the ratio of repayment of funds borrowed on the interbank market); in terms of output volatility, liquidity injections have, however, an ambiguous effect.

Only few models explicitly account for macro-prudential policies in a broader sense. One of them is Kannan *et al*. (2009). The authors examine the potential role of monetary policy in mitigating the effects of asset price booms. Results imply that stronger monetary reactions to signs of overheating or of a credit or asset price bubble could help counter accelerator mechanisms that push up credit growth and asset prices (in line with what Cecchetti *et al*, 2000 argue). This is however, only the case when shocks are of a financial character. For technology shocks, a standard Taylor rule still does best in terms of reducing volatility in output and inflation.

[34] For a positive demand shock, consumer and asset prices increase. This reduces the real value of outstanding debt, positively affecting borrowers' net worth. Simultaneously, the rise in asset prices augments the borrowing capacity of the debtors, allowing them to spend and invest more. As borrowers have a higher propensity to spend than lenders, the net effect on demand is positive, and acts as an amplification mechanism for the initial shock.

[35] At the heart of the propagation mechanism lays a double moral hazard problem à la Holstrom and Tirole (1997).

Gerali et al. (2010) provide for the up-to date only DSGE model incorporating a banking sector, estimated on euro are data. Here banks enjoys some degree of market power (in both the loan and the deposit markets) and accumulate capital subject to a capital adequacy requirement. Due to the interest rate setting behaviour of banks the model accounts for an intermediation spread. This spread alters the pass-through of changes in the policy rate to bank rates, usually at work in standard models with endogenous borrowing constraints but without financial intermediation[36]. Overall, the authors find that banking induces some attenuation on output, mainly reflecting the presence of sticky interest rates. Banking nonetheless enhances the persistence in real variables in response to technology shocks. Finally, the authors assess the contribution of financial shocks to the crisis experienced since 2007 and find that almost all the contraction of real GDP was due to factors that either pushed up the cost of credit or reduced the amount of credit available to the private sector.

Angelini et al. (Forthcoming) introduce interactions and sequencing between monetary and macro-prudential policy, the latter seeking to stabilize the loans/GDP ratio and GDP growth. The paper's preliminary results do so far not to hint an important quantifiable aspect of strategic interactions between monetary and macro-prudential policy makers. Interactions seem, however, to play a role for the cyclicality of the macro-prudential rules tested in the analysis.

Finally, Angeloni and Faia (2009) provide for another framework allowing the study of interactions between bank regulation and monetary policies in fragile banking systems (i.e. when bank runs are possible). Given this framework, households' welfare is optimized by a combination of countercyclical capital ratios and a monetary policy response to asset prices.

[36] The overall effect of intermediation is affected by the stickiness of interest rates (banks translate changes in interest rates only partially) inducing some attenuation. On the other hand, the credit market power and the ensuing mark-up between lending rates and policy rates amplify changes in the policy rate for borrowers, while the markdown between the policy rate and the deposit rate attenuate effects for lenders.

APPENDIX II

The euro area and US models used for simulations

In section 3 on this paper, we rely on models estimated by Antipa, Mengus and Mojon (2010). The models are, for each zone, a DSGE à la Iaccoviello (2005) with residential investment, house prices and housing loans. It should be stressed that, in the model, housing prices influence the investment cycle as in Liu et al. (2009).

The private sector

Both housing and preference shocks intervene in agents' utility functions. In our specification, only impatient households are subject to the marginal utility of housing that in turn affects housing demand. Contrary to Iacoviello (2005) - where changes to the marginal substitution between housing and consumption affect both, patient and impatient households - we are here interested in the interactions between a demand shock on the one hand and a biting borrowing constraint in a framework of nominal debt indexation on the other hand.

Formally, housing preference shocks intervene on φ_t in the constrained households' utility function:

$$E_0 \sum_{t=1}^{\infty} \beta_t^c A_t \log(C_t - \varepsilon C_{t-1}) + \varphi_t \log\left(L_t^h\right) - \xi_t(N_t)$$

where C_t, L_t^h and N_t are consumption, housing and hours worked respectively.

As in Liu et al. 2009, A_t governs the shocks to agent's time preferences; both, impatient and patient households are subject to that shock. The ordering in time preferences is the following: impatient households are more impatient than entrepreneurs who are more impatient than patient households ($\beta_t^c = 0.95;\ \beta_t^E = 0.98;\ \beta_t^R = 0.99$).

The other distinctive feature of this model is the borrowing constraints for entrepreneurs and constrained households. Both types of agents maximize their utility subject, not only to a standard inter-temporal budget constraint, but also to a borrowing constraint that will be binding at equilibrium. These are for borrowers and entrepreneurs respectively:

$$B_t^C \leq \theta_t E_t(q_{t+1} L_t^C)$$

$$B_t^E \leq \theta_t E_t(q_{t+1} L_t^E)$$

Where $E_t(q_{t+1})$ is the expected house price in t+1 and L_t^C and L_t^E are borrowers and entrepreneurs holdings in housing wealth respectively, i.e. borrowing is limited to the net present discounted value of housing wealth. A positive financial shock can therefore be understood as a relaxation of borrowers/entrepreneurs loan to value ratio (caused by an increase in competition in the banking sector or financial innovation for instance). These constraints are binding equalities at equilibrium.

The model was estimated separately for the the US and the euro area based on quarterly observations from 1985 to 2009. The observable used for the estimation are GDP, consumption, residential investment, inflation, the money market rate, housing loans and the house prices. Trending variables were de-trended with either HP filter or a linear trend except for housing prices and total credit. This is to avoid that too much of the housing bubble dynamic, which has been very persistent, is erased by the

de-trending procedure. The estimated parameters are reported in Appendix II, and the Dynare programs used for the simulations are available upon request to Antipa *et al*. (2010).

Government policies

Following a standard approach, we evaluate the potency of MP policies by simulating the effects of various shocks in the model across three of the four archetypical policy regimes listed in section 2.1:

1. The Plain Vanilla Taylor rule

This reaction function of the central bank has her adjust the level of short-term interest rates in response to deviations of inflation from the inflation objective (here we chose 1.9 % to be consistent with the ECB monetary policy strategy) namely the inflationary gap $(\pi_t^C - 1.9)$ and in response to the gap between current output and potential output $(y_t - y_t^*)$. The relationship can be expressed as

$$r_t = (1 - \gamma_R)\left[\gamma_\pi(\pi_t^C - 1.9) + \gamma_y(y_t - y_t^*)\right] + \gamma_R r_{t-1}$$

where γ_R denotes the inertia of interest rates and γ_π and γ_y are the coefficients assigned to the reactions to the inflationary and output gaps respectively.

2. Lean against the wind Taylor rule

In this second policy regime, the central bank also raises interest rates in reaction to the growth rate of credit. The monetary policy rule can then be expressed as

$$r_t = (1 - \gamma_R)\left[\gamma_\pi(\pi_t^C - 1.9) + \gamma_y(y_t - y_t^*) + \gamma_b(b_t - b_{t-1} + \pi_t^C)\right] + \gamma_R r_{t-1}$$

where $b_t - b_{t-1} + \pi_t^C$ reflects the nominal growth rate of credit (γ_b being the corresponding weight within the policy rule).

3. Independent Macro-prudential Policy

In this third regime, we have both the same monetary policy rule as in Regime 1, i.e.

$$r_t = (1 - \gamma_R)\left[\gamma_\pi(\pi_t^C - 1.9) + \gamma_y(y_t - y_t^*)\right] + \gamma_R r_{t-1}$$

and the lean against credit rule. The latter rule impacts upon agents' borrowing constraints by affecting their respective loan to value ratios. The equation for the time-varying loan to value ratio, and hence the credit rule, is:

$$\theta_t = \mu * \left(\left(1 + \varepsilon_t^\theta\right) * \left(\frac{B_c + B_e}{B_{c-1}^{SS} + B_{e-1}^{SS}}\right)\right)^{-\tau}$$

where ε_t^θ is a shock to the loan to value ratio, and has to be understood as a credit supply shock. B_c and B_e are impatient households' and entrepreneurs' respective debt levels (B_{c-1}^{SS} and B_{e-1}^{SS} are their steady-state levels). Finally, τ governs the strength of the policy-makers reaction to excessive credit growth.

This is a combination of the plain vanilla Taylor rule and an independent policy instrument which reacts to the growth rate of nominal credit thus constraining agents' loan-to-value ratio and hence the amount of overall credit.

APPENDIX III

Limitations of the model and of the simulation exercises performed with it

The exercise developed in this section allows us to gain insights on the interaction between monetary and macro-prudential policies. However, several limits in the analysis should be acknowledged. It is nevertheless also fair to emphasize that, although they might call for further significant developments, these limits are mainly entrenched in any modeling exercise. Consequently, most of them would also apply to a wider range of modeling exercises.

1. Uncertainty about the model (is this DSGE model a good representation of the actual economy ?)

Building a model involves choosing a set of simplifying assumptions. An important one is that the economy is isolated from the rest of the world. However, domestic financial stability and domestic inflation rates are affected by what happens in the rest of the world and in big foreign economies. A drawback of considering the economy as a single entity is that the issues of both the international coordination of those two policies and the quantification of their importance cannot be addressed.

Another important issue is the modeling of the financial imperfections and of their impact on the business cycle. As evident from Table 2.1 and from the simulations reported in Figure 3.1a to 3.9, credit developments have only a limited effect on the dynamics of real and nominal variables. This could be because the financial cycle is longer-lasting and more asymmetric than the real business cycle and, the models are estimated over samples during which monetary policy has managed to dampen inflation fluctuations.

More generally, the model only focuses on a specific form of credit rationing. There is no role for a fall in the demand for credit and for an increase in the savings rate, which have been observed for some agents during the crisis. Moreover, liquidity hoarding by banks is a sign of effective self-insurance on the part some financial institutions, which is not present in the model. A new literature studies uncertainty shocks and precautionary savings (Bloom, 2009) in order to explain fall in activity when uncertainty increases, which can create negative externalites. This model abstract from all of that and, once again, focuses on only one margin.

Credit constraints capture the difficulties for entrepreneurs to get financed. Admittedly, they capture market freeze during financial turmoil, which may be linked to market liquidity. Dealing with this effect in such a reduce-form way allows to estimate simply the effect at stake, but the market failure for funding and market liquidity are different, and so are the optimal policy answer. Interactions between funding and market liquidity are studied by a recent literature (see e.g. Brunnermeier and Pedersen, 2009), which however does not provide quantitative insight yet.

2. Uncertainty about the policy function objective

The postulated policy objectives and the associated reaction functions are intuitive and tractable. However, they are not derived from primitive parameters describing the preferences of the agents the public authority aims at maximizing. In particular, it might the case that the relative weight given to each of the target variables in the rule (or in the loss function) differs from the optimal one that these primitive parameters would imply.

3. Uncertainty about the estimated coefficients; econometric structure (time-varying parameters, heteroskedasticity, etc)

Simulating the economy under different policies is based on estimated parameter values. These estimates are thus prone to estimation uncertainty which could also be included in the simulations. More generally, tackling the uncertainty concerning the parameters' values could call for considering that the structure of the model is itself uncertain, and for including this as a feature of the estimation procedure. For instance, one may allow for time-variation in either the parameters describing the transmission mechanism of the structural shocks to the macroeconomic aggregates, or the ones characterizing the variance of the structural shocks.

4. Policy-dependence of the estimated parameters (the so-called Lucas critique)

Along the same lines, using estimated coefficients to conduct policy simulations is prone to the so-called Lucas critique. The estimation strategy postulates a given structure of the economy. This structure involves, among other elements, the parameters characterizing the policy reaction function. In particular, private sector's agents take their decisions conditional on this policy rule (and these specific parameters). Therefore, a shift in the policy rule may affect the structure of the economy and require re-estimating the model under the new structure. However, for this to be implementable, we would need data under a regime where macro-prudential policy already existed.

5. Uncertainty about the data: revisions (i.e. Orphanides)

The simulations are based on final releases of macroeconomic aggregates. By contrast, public authorities take decisions in real time and therefore rely on real-time data that are subsequently updated and sometimes differ substantially from final figures. This is especially relevant when the economy experiences big disruptions whose consequences are difficult to interpret in real time and thus take time to be learned. It may therefore be interesting to see how the conclusions of the exercise would differ if the policy reacted to these real-time data.

6. Uncertainty about the central bank's (or other authority's) ability to implement the policy

In the model, we assume in particular that the authorities can lean against credit.

a. information (about the agents and the economy) needed to implement (optimal) policy, (i.e. Orphanides and Williams)

The uncertainty behind the parameter estimates alluded above is more than just a matter of econometrics methodology. It is reasonable to assume that public authorities may have an informational advantage, compared to the private sector in monitoring and processing statistical information, and therefore have a more precise view of the evolution of the macroeconomic outlook. They nevertheless still remain uncertain about the exact structure of the economy. By comparison the proposed simulation exercise postulates that the authorities have an accurate perception of this structure. An extension would be to analyze a situation where the objective function of the central bank (or other authority) incorporates their own uncertainty about this complex structure. This would influence their optimal decisions (and therefore the optimal reaction function). For instance they might want to minimize the loss under the less favorable scenario induced by their approximation instead of the scenario where the economy behaves as described by the "point estimates" of the models parameter.

b. political economy

The model considers a macro-prudential authority which is well settled and independent from national governments. It therefore abstracts from the process of setting-up this new regulatory body. However,

national or industrial vested interest may stall this process. This would pave the way for time-inconsistency problems due to non-credible commitments to restrict credit growth when the macroeconomic outlook calls for it.

APPENDIX IV
ADDITIONAL TABLES AND FIGURES

Table 3.1: Variance decomposition in of macroeconomic variables between 1985 & 2010

Euro area

	Invest. Specif.	Productivity	Demand	Housing pref	Credit sup.	Mon Pol	Demand gx	Mark up
GDP	43.27	0.44	10.75	6.83	0.19	9.77	4.64	24.10
Consumption	33.69	0.57	13.04	6.16	0.17	12.69	1.11	32.57
Investment	75.65	0.33	4.63	9.25	0.18	3.15	0.28	6.54
Inflation	2.15	13.62	19.43	3.03	0.10	8.68	1.65	51.34
Interest rate	2.72	11.98	56.29	9.10	0.39	7.26	7.39	4.87
House prices	1.34	0.95	0.06	96.78	0.05	0.18	0.23	0.42
Credit	0.15	0.04	0.10	41.29	58.09	0.12	0.01	0.18
Wages	5.60	70.08	1.78	8.72	0.06	4.77	8.34	0.65
Inflation annual	2.85	12.63	25.86	4.48	0.15	11.06	2.45	40.51

United States

	Invest. Specif.	Productivity	Demand	Housing pref	Credit sup.	Mon Pol	Demand gx	Mark up
GDP	31.30	61.20	0.10	0.13	0.01	0.08	3.42	3.77
Consumption	20.89	74.04	0.09	0.09	0.01	0.08	0.50	4.30
Investment	75.24	21.43	0.12	0.3	0.01	0.05	0.97	1.88
Inflation	2.81	32.19	9.39	0.86	0.09	5.82	2.60	46.23
Interest rate	9.88	11.66	46.15	5.88	0.76	4.99	7.17	13.49
House prices	13.89	76.21	0.10	8.39	0.01	0.04	0.38	0.99
Credit	2.38	4.67	0.25	33.01	58.63	0.04	0.19	0.83
Wages	8.57	74.88	0.38	2.42	0.05	2.07	9.86	1.77
Inflation annual	3.29	33.61	12.12	1.29	0.12	5.85	3.04	40.69

Table A.1: Estimated and optimized coefficients of the policy rules, United States

		Interest rate	Inflation	GDP	Credit	Macro Prudential Policy
	Estimated Talor rule coefficients	0.81	2.02	1.00		
	Optimized coefficients (weights inflation, GDP, and interest variability =1)					
	Joint optimisation of all policy parameters in each regime					
1	Plain Taylor rule	0.59	1.45	1.49	-	-
2	Augmented Taylor rule	0.67	1.49	0.55	0.11	-
3	PTR + macro-prudential	0.59	1.45	1.49	-	0.73
4	ATR + macro-prudential	0.68	1.50	0.34	0.08	0.52
	Optimisation of Taylor rule coefficients for a given macro-prudential policy (tau=0,5)					
5	Plain Taylor rule	0.93	1.50	0.14	-	0.50
6	Augmented Taylor rule	0.68	1.50	0.30	0.08	0.50
	Optimized coefficients (weights on the variability of inflation= 1, GDP= 0.05 and interest rate= 5)					
	Joint optimisation of all policy parameters in each regime					
7	Plain Taylor rule	0.76	2.06	1.03	-	-
8	Augmented Taylor rule	0.80	2.00	1.00	0.03	-
9	PTR + macro-prudential	0.85	2.00	1.03		0.51
10	ATR + macro-prudential	0.81	2.00	1.00	0.01	0.50
	Optimisation of Taylor rule coefficients for a given macro-prudential policy (tau=0,5)					
11	Plain Taylor rule	0.91	2.01	0.97	-	0.50
12	Augmented Taylor rule	0.82	2.00	0.99	0.02	0.50

Table A.2: Standard deviations and value of the loss functions across regimes, United States

		GDP	CPI	TX	Loss 1	Loss 2	Credit
	Stabilization effects of optimized policies (weights inflation, GDP, smoothing =1)						
1	Plain Taylor rule	0.44	0.65	0.64	1.73	-	1.12
2	Augmented Taylor rule	0.77	0.36	0.57	1.70	-	1.10
3	PTR + macro-prudential	0.39	0.46	0.74	1.63	-	0.68
4	ATR + macro-prudential	0.85	0.47	0.73	2.05	-	0.62
	Stabilization effects of optimized policies (constrained by given macro-prudential policy)						
5	Plain Taylor rule	1.21	0.66	0.36	2.23	-	0.64
6	Augmented Taylor rule	0.87	0.48	0.73	2.08	-	0.64
	Stabilization effects of optimized policies (weights inflation 1, GDP 0.05, smoothing 5)						
7	Plain Taylor rule	0.59	0.25	0.57	-	3.13	1.11
8	Augmented Taylor rule	0.62	0.25	0.54	-	2.98	1.11
9	PTR + macro-prudential	0.65	0.23	0.57	-	3.11	0.63
10	ATR + macro-prudential	0.64	0.24	0.60	-	3.29	0.64
	Stabilization effects of optimized policies (constrained by given macro-prudential policy)						
11	Plain Taylor rule	0.65	0.26	0.42	-	2.41	0.64
12	Augmented Taylor rule	0.65	0.24	0.60	-	3.26	0.64

note: loss is the sum of the first three columns, loss 2 takes into account the weight of variables in the loss function

FIGURES

Figure 3.1:Effects of Various Shocks on Inflation, US

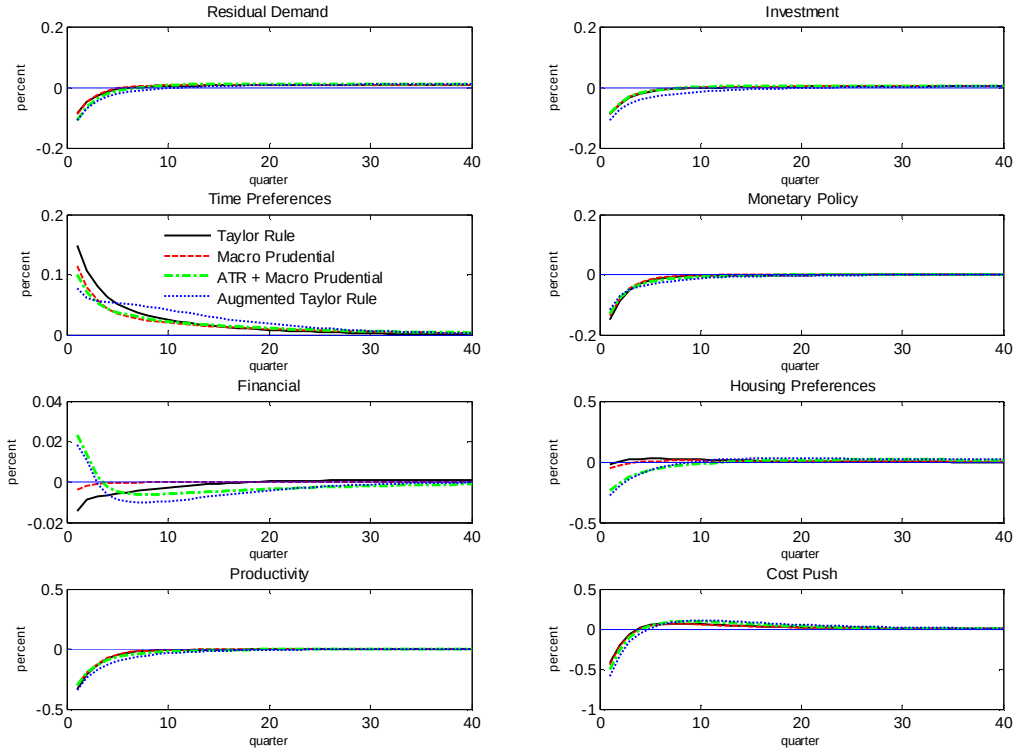


Figure 3.2:Cost Push Shock, Euro Area

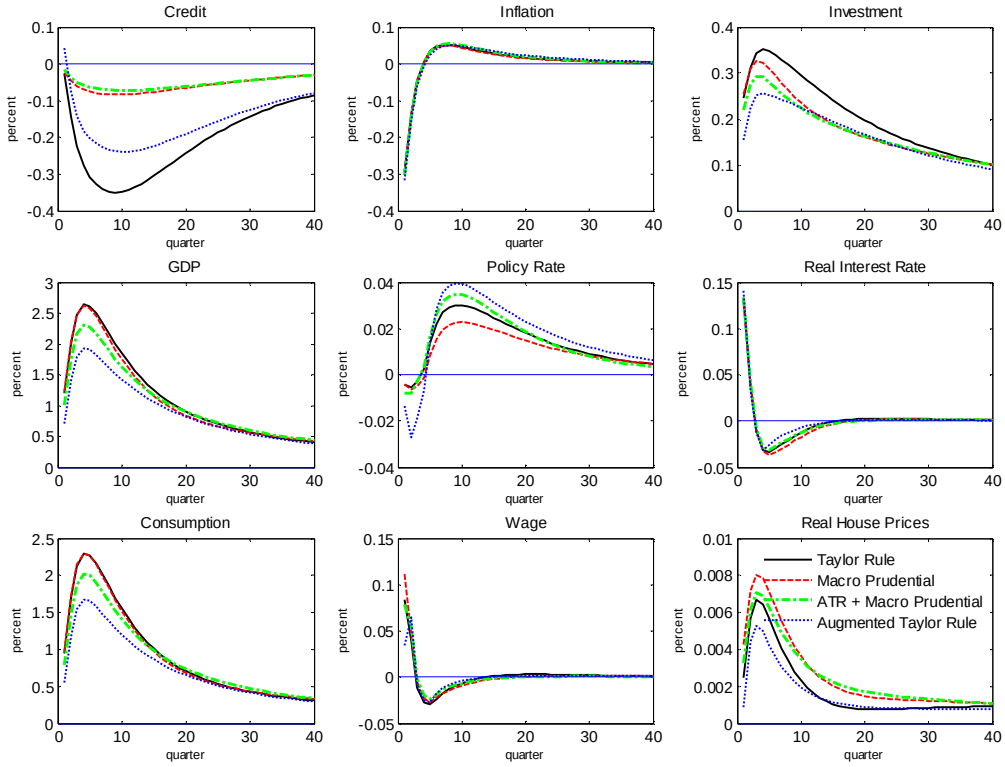


Figure 3.3:Investment Specific Shock, Euro Area

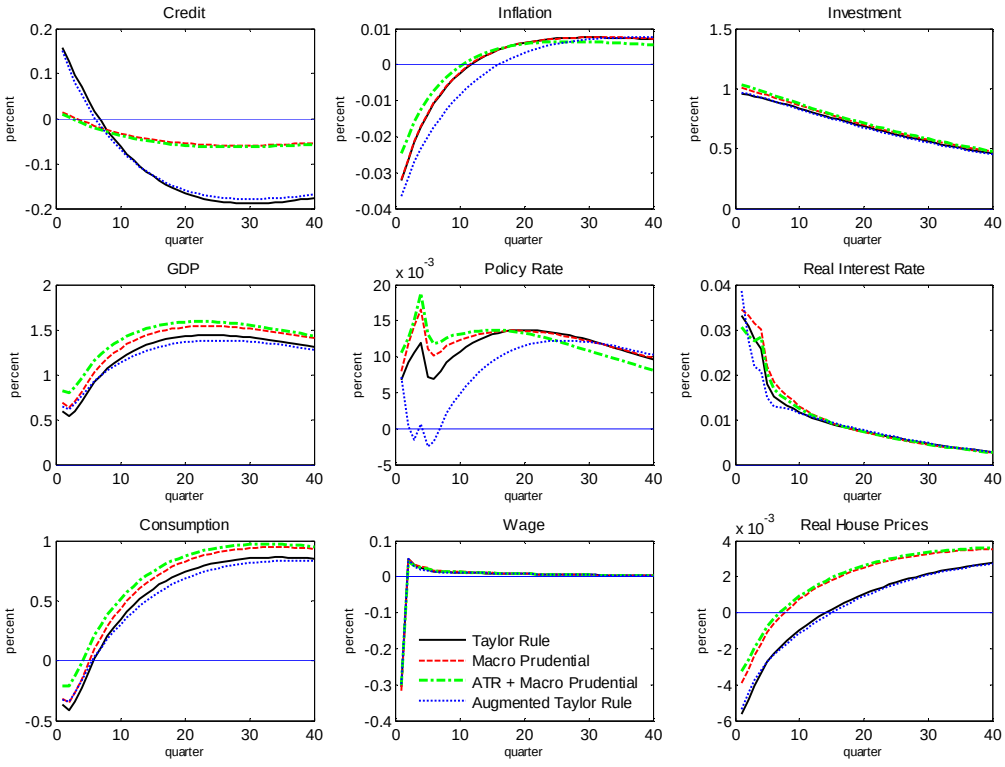


Figure 3.4:Monetary Policy Shock, Euro Area

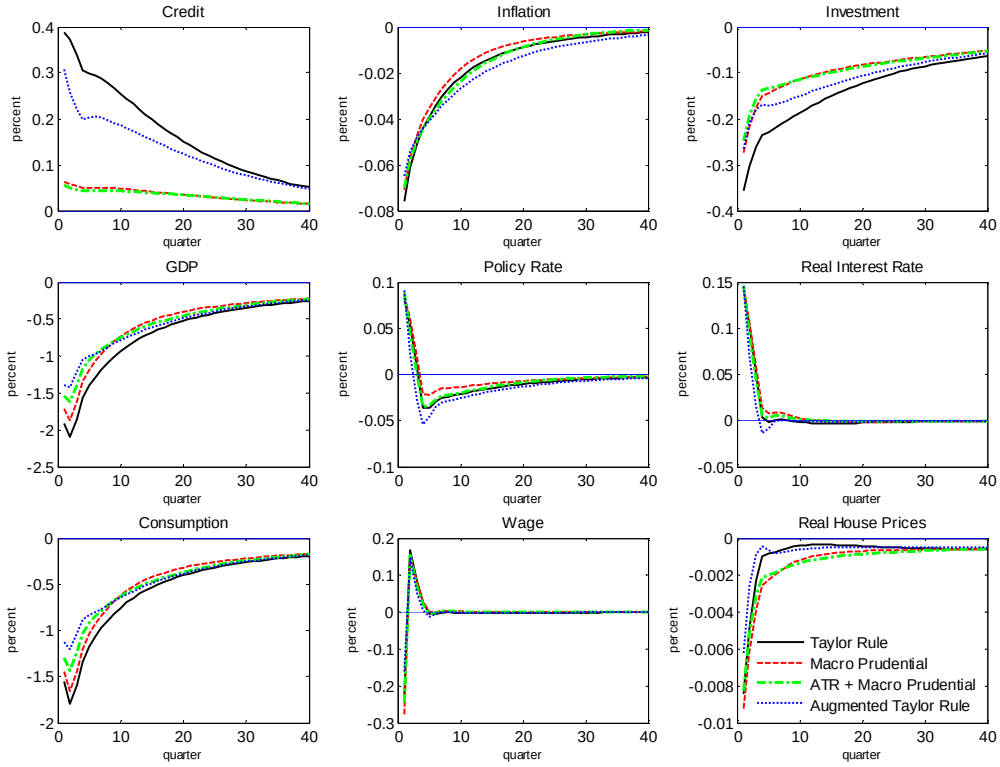


Figure 3.5:Productivity Shock, Euro Area

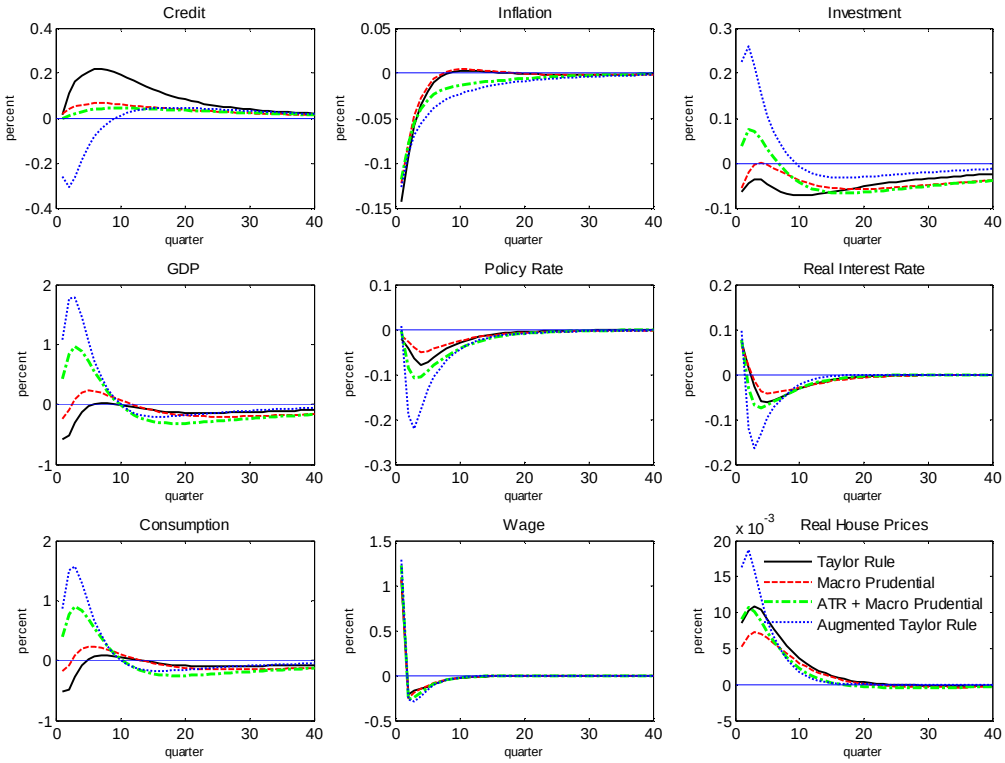


Figure 3.6:Residual Demand Shock, Euro Area

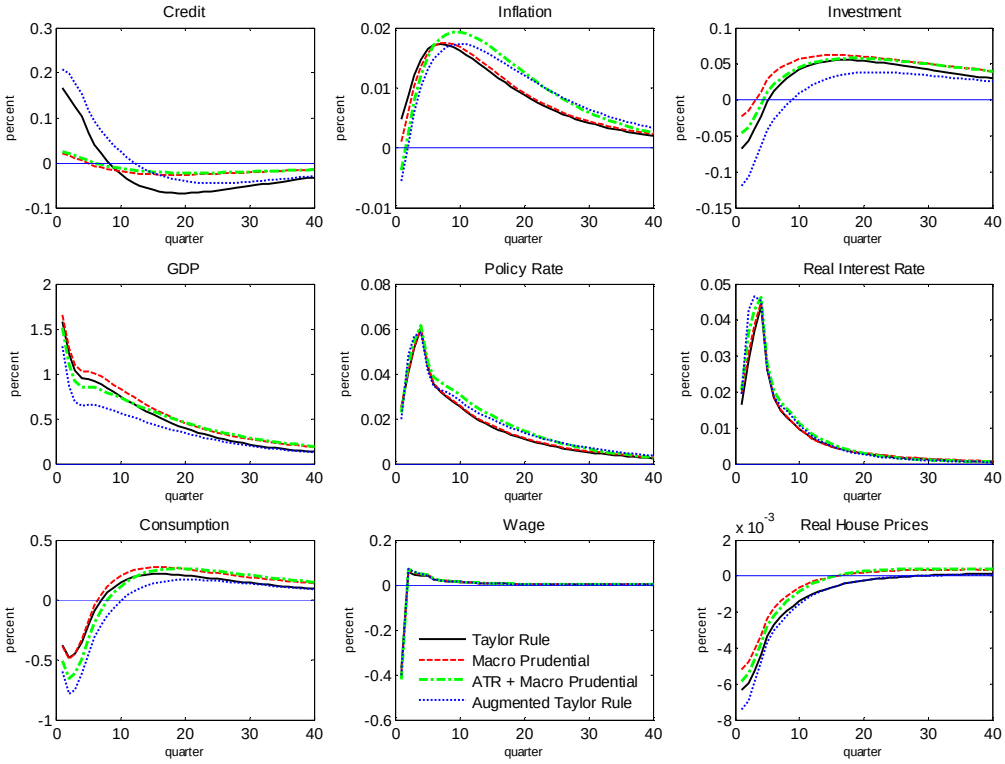


Figure 3.7:Housing Preferences Shock, Euro Area

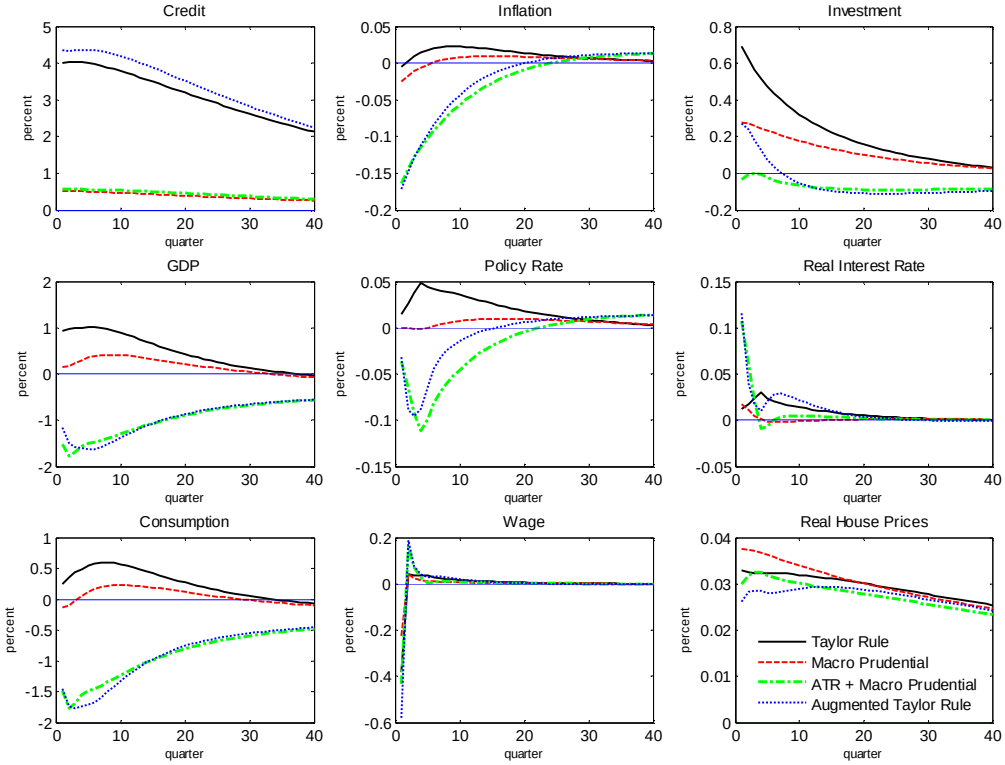


Figure 3.8:Financial Shock, Euro Area

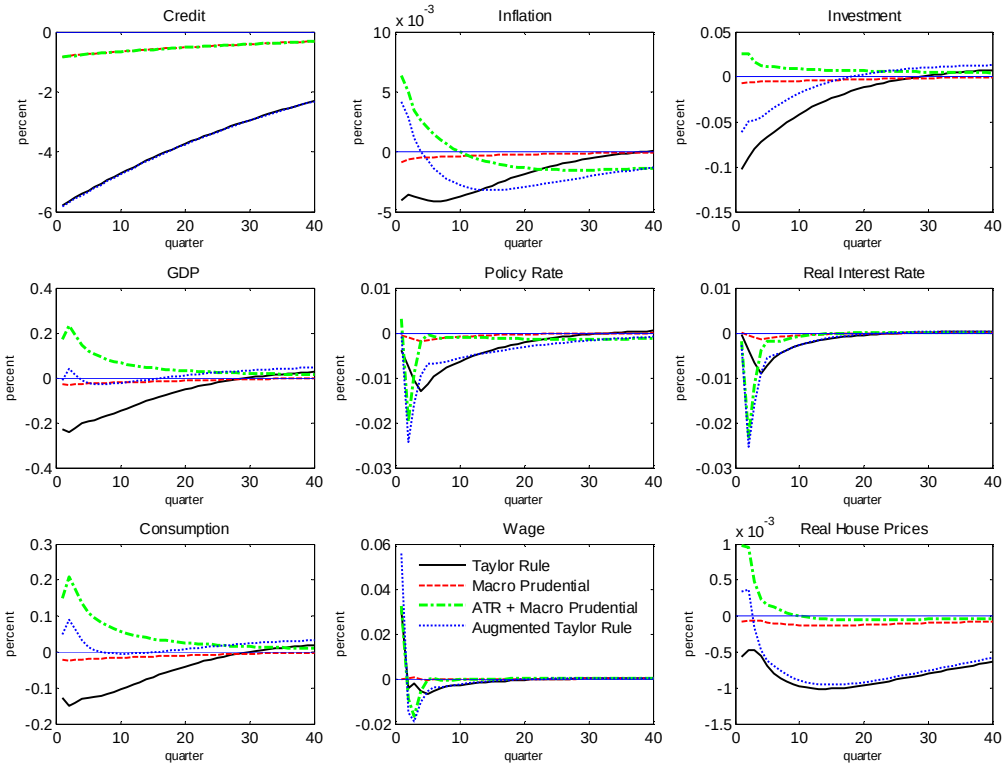


Figure 3.9:Time Preferences Shock, Euro Area