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MONETARY POLICY**

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Macro-Prudential Policy and the Conduct of Monetary Policy

Denis BEAU, Laurent CLERC and Benoît MOJON

Résumé:

Dans cet article, nous analysons les interactions entre la politique monétaire et la politique macro-prudentielle et les circonstances dans lesquelles ces interactions appellent une mise en œuvre coordonnée des deux politiques. Nous commençons par un examen des interdépendances entre les politiques monétaire et macro-prudentielle. Ensuite, nous utilisons un modèle DSGE intégrant des frictions financières, des agents hétérogènes et l'investissement en logement. Le modèle, qui est estimé pour l'économie de la zone euro sur la période 1985-2010, nous permet d'identifier les circonstances dans lesquelles la politique macro-prudentielle a des effets qui renforcent, qui sont neutres ou qui sont contradictoires avec l'objectif de stabilisation des prix de la politique monétaire.

Nous comparons la dynamique de l'inflation dans quatre «régimes politiques», donnés par le croisement de deux options:

- (a) l'instrument de la politique, le taux d'intérêt à court terme réagit ou ne réagit pas à la croissance du crédit, et
- (b) l'existence, ou non, d'une autorité en charge d'un objectif de stabilité financière à travers la mise en œuvre de politiques macro-prudentielles qui limite les variations du crédit directement indépendamment du taux d'intérêt à court terme.

Notre principal résultat est que dans la plupart des circonstances, des politiques macro-prudentielles interfèrent très marginalement avec la stabilisation de l'inflation poursuivie par la politique monétaire.

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

Mots-clés: Politique monétaire, stabilité financière, politique macro-prudentielle

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 the euro area 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 result is that under most circumstances, macro-prudential policies have either a limited or a stabilizing effect on inflation.

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

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

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 tracks 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 two questions: First, 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? Second, how large is this risk?

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 a DSGE model estimated using time series of euro area macroeconomic variables over the period 1985-2010. These simulations allow us to assess the circumstances under which macro-prudential may have compounding, neutral or conflicting outcomes that interfere with the pursuit of price stability by monetary policy.

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 oriented 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 on the real economy.

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

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.

system as a whole, not just of its 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 Coordination within the new institutional arrangements

Box 1 below presents the main features of the new institutional arrangements recently adopted in Europe 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 1: 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 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 led to the inception of 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 Larosi re 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 in July 2010 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 is in charge of identifying, monitoring

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

and addressing systemic risks posed by large and complex financial firms, and of making recommendations to regulators. It is 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 is able to provide direction to, and request data and analyses from, the Office of Financial Research (OFR). Being within the Treasury Department, this Office contributes 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 is therefore 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 is 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 has been created within the Bank of England with the responsibility for maintaining financial stability. This committee works 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 ESRB is drawing heavily from the knowledge and the experience of the Eurosystem. Additionally, the ECB provides the ESRB with analytical, statistical, administrative and logistical support. National central banks and supervisors also provide technical advice, which 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 has the possibility to issuing warnings and recommendations. The institutional arrangement, which brings together since January 2011 central bank governors and heads of supervision, should ensure both effective coordination and information-sharing. The ESRB is 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 cannot designate individual financial institutions.

Its tools are based on the obligation to "comply-or-explain". Therefore, even though the ESRB does not have formal directive power and the comply-or-explain obligation is not 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) is independent from the Fed and is chaired by the US Treasury. The Fed however participates, jointly with other regulators, in the FSOC and supports 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 effectively inform the conduct of monetary policy. It should however be noted that the Fed is still 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.

In Europe, the European Systemic Risk Board is distinct and separate from the ECB. It does 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 plays 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 has been created within the Bank of England. It is separate from the Monetary Policy Committee and has an overall membership of 11, including internal members from the Bank of England. The remaining five members are from outside the Bank, including a Treasury representative. This new committee is chaired by the Governor and includes 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 is 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 aspect 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 1 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. **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 risk⁵. 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 new regulatory frameworks tend to favour institutional setups involving several institutions or layers. This should imply close coordination between entities in charge of micro and macro prudential regulations

⁵ 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.

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.

Recent research has focused on 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.

2.3 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 1 below for an overview), and, exactly as monetary policy, are intended to modify private agents’ behaviour.

The likelihood of an interaction between macro-prudential and monetary policies originates from the focus of, macro-prudential policies -on monetary and financial institutions⁶. These institutions turn out to be central banks' counterparts in their provision of liquidity to the economy.

Table 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	<ul style="list-style-type: none"> Capital ratio Risk weights Provisioning Profit distribution restrictions Credit growth cap 	Bank lending Broad credit Balance sheet
		Lending contract	<ul style="list-style-type: none"> LTV cap Debt service/income cap Maturity cap 	Bank lending
	Non-bank investor			
	Securities market		<ul style="list-style-type: none"> Margin/haircut limits 	Collateral
	Financial infrastructure			
Liquidity or market risk	Bank / deposit taker	Balance sheet	<ul style="list-style-type: none"> Liquidity/reserve requirements FX lending restrictions Currency mismatch limit Open FX position limit 	Bank lending Balance sheet
		Lending contract	<ul style="list-style-type: none"> Valuation rules 	Balance sheet Collateral
	Non-bank investor		<ul style="list-style-type: none"> Local currency or FX reserve requirements 	Balance sheet
	Securities market		<ul style="list-style-type: none"> Central banks balance sheet operations 	Collateral Portfolio
	Financial infrastructure		<ul style="list-style-type: none"> Exchange trading 	
Inter-connectedness	Bank / deposit taker	Balance sheet	<ul style="list-style-type: none"> Capital surcharge for SIFIs 	Bank lending
		Lending contract		
	Non-bank investor			
	Securities market			
	Financial infrastructure		<ul style="list-style-type: none"> Central counterparty 	Interest rate

Source: CGFS (2010) and Banque de France

⁶ 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.

2-5 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).

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.⁷ 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 shifting⁸, 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,⁹ 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 papers¹⁰ 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 France¹¹ 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.¹²

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.¹³ In section 3 we resort to estimated DSGE models to illustrate this point.

⁷ See Rajan (2006) and Borio and Zhu (2008).

⁸ See De Nicolo, *et al.* (2010)

⁹ See Altunbas, Gambacorta and Marques (2010).

¹⁰ See Vasso *et al.* (2008) and Ciccarelli, Maddaloni and Peydro (2009).

¹¹ See Dubecq, Mojon and Ragot (2010).

¹² See Taylor (2009) and Obstfeld and Rogoff (2009).

¹³ 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: 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

Economists typically use micro-founded models, where behavioural assumptions are invariant with respect to the policy regime, 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).¹⁴ 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.

As of today, only very few papers¹⁵ have proposed a formal assessment of the effects of macro-prudential policies on price stability. In a recent contribution, N'Diaye (2009) shows that raising

¹⁴ 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; de Fiore and Tristani; Karadi and Gertler; Gertler, Kiyotaki and Queralto (2010); Brunnermeier et al. (2012) and references therein.

¹⁵ 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

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.

We describe such mechanisms in models that have been estimated over the period 1985-2010 for the euro area (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 euro area business cycle over the last 25 years, as captured by our estimates.

3.2 Modelling monetary and macro-prudential policies

We then consider whether alternative policy regimes 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.
- 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.

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

(2010), and Antipa, Mengus and Mojon (2010). See also Kashyap and Stein (2010), Fahr S., Rostagno, Smets F. and Tristani O. (2010).

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 Borghy, Clerc and Renne (2011) for a comprehensive analysis of early warning indicators of financial crises- led recessions.

of credit or of maturity transformation.¹⁹ We abstract from the discussion of the most appropriate instruments to lean against credit altogether, in order to focus instead on the macroeconomic effects of such stabilisation policies.

Turning to the specific coefficients of the policy rules, we proceed first with a simplest initial calibration of Taylor rule for the benchmark regime, with coefficients of 1.5 on inflation and 0.5 on the output gap²⁰, with an autoregressive coefficient of 0.9. The augmented Taylor rule uses an ad hoc coefficient of 0.7 on the log level of nominal credit. This magnitude is meant to have an effect of credit on the variance of the interest rate in between the variance due to inflation and that due to the output gap. In terms of the macro-prudential policy that affects directly the loan to value ratio in the model, we set $\tau=0.5$ in

$$\theta_t = \bar{\theta} z_t^\theta \left(\frac{b_t}{\bar{b}} \right)^{-\tau}$$

3.3 A typology of shocks and their effects on price stability

We now turn to comparing the dynamics of inflation across regimes. 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.²¹ 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 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.²²

We use the estimated model 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.

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.

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 The larger the weights on output variability in the loss function, the more the monetary policy maker cares about output variability. 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 than for the Eurosystem, whose mandate is primarily to focus on price stability. In the later case we could in principle assume that that only inflation variability matters to the central bank. 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.

²¹ This point is also illustrated in Kannan, Rabanal and Scott (2009) and Angeloni and Faia (2010).

²² On the trade-off between financial stabilization and the cost to the credibility of the inflation objective, see the illuminating discussion of Carney (2009).

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 are reported in Table 3.

Table 3: Variance decomposition according to our estimated model					
	Housing pref	Productivity	Credit supply	Cost push	Monetary policy
Credit	5.37	23.37	49.89	7.29	5.72
House price	34.15	44.84	0.17	10.06	2.75
Interest rate	3.74	19.85	0.12	57.41	14.79
Output	1.30	56.19	0.18	31.04	7.96
Inflation	0.58	38.72	0.10	54.06	3.64
% of total variance.					

These variance decompositions point to those shocks that are the most important ones for the variance of inflation are shocks to mark-up and productivity and to a much lesser extent, monetary policy. Hence, an authority that cares about stabilizing inflation should care mostly on the potential perturbation due to the pursuit of macro-prudential policy following such shocks. However, this variance decomposition may not be entirely robust and we compare the dynamics of inflation for all identified shocks in the model.

In any events, the most relevant point of our analysis is to describe whether the four policy regimes imply differences in inflation dynamics. Hence we report the response of inflation to all the estimated shocks of the model in Figure 1. First, the responses of inflation to technology, cost-push and monetary policy shocks are almost identical across the four policy regimes. And these three shocks account for 90 % of the variance of inflation.

The dynamics of inflation differ for other shocks. In particular, the augmented Taylor rule can be destabilizing for inflation if compared to the benchmark plain vanilla Taylor rule regime. This is the case following either the housing preference shock or the financial shock. As can be seen in Figure 2, which reports the effects of a financial shock, the augmented Taylor rule implies an abrupt increase in the real interest rate which turns out destabilising for output and inflation. In contrast, the combination of a standard Taylor rule and a target macro-prudential rule (in the policy regime iii), turns out both more stabilising for credit (see also Figure 3 and 4) and non-destabilising for inflation.

Further insights on the dynamics implied by the various monetary policy regimes can be gained through a counterfactual analysis of how the economy would have reacted if macroprudential policies would have been in place. For this we plug in the model the structural exogenous shocks that we estimated together with the model's parameters and run a dynamic simulation of the economy for each of our four policy regimes. The results are reported in Figure 5 for GDP growth, inflation, the quarterly short-term interest rate and credit.

We see first that an Augmented Taylor Rule imply very large variations in interest rates, with dramatic effects on inflation (dP) and, effectively, a deeper recession in 2009 than the one we had (dy). Second, we obtain that the macro-prudential rule has a large effect in dampening the fluctuations of credit (dB). Yet the depth of the recession is not very much affected. This last result also illustrates one weakness of the model within which the interaction between credit and the business cycle is fairly limited.

Altogether, 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.

4. Conclusion

In this paper, we analyse the interactions how macro-prudential policy may affect the conduct the performance of monetary policy. First we discuss the set up of institutions in charge of macro-prudential policy in the US and in Europe and the potential conflict that this new policy may have with monetary policy.

We then 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, 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. And for the shocks that have explained most of the fluctuation in inflation, whether monetary policy leans against financial winds or not, and whether we have an additional macro-prudential policy instrument active or not, makes hardly any difference for the dynamics of inflation.

We also show 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.

Assuming that such a finding is robust across different sample periods and countries, 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.

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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 and 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 period²³.

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) analysis²⁴, 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)²⁵ 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

²³ 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).

²⁴ Based on the costly state verification model by Townsend (1979)

²⁵ 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 shocks²⁶, 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 a 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 shocks²⁷. 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.

²⁶ 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.

²⁷ 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 area data. Here banks enjoy 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 intermediation²⁸. 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 hint an important quantifiable aspect of strategic interactions between monetary and macro-prudential policy makers. Interactions seem, however, to play a role for the cyclicity 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.

²⁸ 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 model used for simulations

In section 3 of this paper, we rely on a modified version of the models estimated by Antipa, Mengus and Mojon (2010), in which we consider impatient entrepreneurs and patient (or ricardian) households only. The model is a DSGE à la Iacoviello (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

Only housing shocks intervene in agents' utility functions. In our specification, patient 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:

$$E_0 \sum_{t=0}^{\infty} (\beta^R)^t \log(C_t) + \varphi_t \log(L_t^h) - \frac{1}{1+\eta} (N_t)^{1+\eta}$$

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

The ordering in time preferences is the following: entrepreneurs are more impatient than patient households ($\beta^E = 0.975$; $\beta^R = 0.9943$, see Gerali et al., 2009). We take $\eta = 1$.

The other distinctive feature of this model is the borrowing constraints for entrepreneurs. Entrepreneurs 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. This borrowing constraint is given by:

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

where $E_t(q_{t+1})$ is the expected house price in $t+1$ and L_t^E is entrepreneurs holdings in housing wealth., and $\theta_t = \bar{\theta} z_t^\theta$ the loan-to-value ratio with z_t^θ an AR(1) shock ($\bar{\theta} = 0.35$ as in Iacoviello, 2005). Borrowing is thus limited to the net present discounted value of housing wealth. A positive financial shock, z_t^θ , can therefore be understood as a relaxation of 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 for the euro area based on quarterly observations from 1997:IV to 2011:II. The observable used for the estimation are GDP, consumption, residential investment, inflation, the money market rate, housing loans and the house prices. Observations are used in first difference of logged variables, except for housing prices timeseries which is used in fourth difference to get rid of seasonal variations. Only the parameters relative to the shocks (standard deviation and persistence coefficients) and the monetary policy reaction function are estimated through bayesienne procedure.

The remaining parameters are calibrated according to previous studies. The estimated parameters are reported at the end of the present appendix. Dynare codes used for the estimation and simulations are available upon request from the authors.

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 reflects the adjustment of level of short-term interest rates in response to lagged deviations of inflation, $\hat{\pi}_{t-1}^C$, and output, \hat{y}_{t-1} , from their respective steady state values. The relationship can be expressed as

$$r_t = (1 - \gamma_R)[\gamma_\pi \hat{\pi}_{t-1}^C + \gamma_y \hat{y}_{t-1}] + \gamma_R r_{t-1} + z_t^r$$

where γ_R denotes the inertia of interest rates and γ_π, γ_y are the coefficients assigned to the reactions to the inflationary and output gaps respectively. z_t^r denotes an AR(1) monetary shock.

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

$$r_t = (1 - \gamma_R)[\gamma_\pi \hat{\pi}_{t-1}^C + \gamma_y \hat{y}_{t-1} + \gamma_b \hat{b}_{t-1}] + \gamma_R r_{t-1} + z_t^r$$

where \hat{b}_{t-1} denotes the lagged deviation of real credit with respect to its steady state value (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.

$$r_t = (1 - \gamma_R)[\gamma_\pi \hat{\pi}_{t-1}^C + \gamma_y \hat{y}_{t-1}] + \gamma_R r_{t-1} + z_t^r$$

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:

$$\theta_t = \bar{\theta} z_t^\theta \left(\frac{b_t}{\bar{b}} \right)^{-\tau}$$

where z_t^θ is an AR(1) shock to the loan to value ratio, and has to be understood as a credit supply shock. b_t is the entrepreneurs' debt level (\bar{b} its steady-state level). 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.

Parameter estimates

Symbol	Description	Prior ^(a)	Posterior mode ^(b)
<i>Shocks' persistence parameter</i>			
ρ_{φ}	Housing shock	Beta (0.8,0.05)	0.9390 (0.0165)
ρ_g	External/Gov. shock	Beta (0.8,0.1)	0.7911 (0.0433)
ρ_t	Technology shock	Beta (0.8,0.1)	0.6821 (0.0293)
ρ_{θ}	Loan-to-value ratio shock	Beta (0.8,0.1)	0.9322 (0.0229)
ρ_p	Cost-push shock	Beta (0.8,0.1)	0.8362 (0.0093)
ρ_i	Investment shock	Beta (0.8,0.1)	0.5380 (0.0558)
<i>Standard deviation of shocks' innovation</i>			
σ_h	Housing shock	Inverse Gamma (0.01,0.02)	0.0861 (0.0250)
σ_g	External/Gov. shock	Inverse Gamma (0.01,0.02)	0.0124 (0.0012)
σ_t	Technology shock	Inverse Gamma (0.01,0.02)	0.0196 (0.0021)
σ_{θ}	Loan-to-value ratio shock	Inverse Gamma (0.01,0.02)	0.0239 (0.0024)
σ_p	Cost-push shock	Inverse Gamma (0.01,0.02)	0.0040 (0.0005)
σ_i	Investment shock	Inverse Gamma (0.01,0.02)	0.0548 (0.0068)
σ_r	Monetary shock	Inverse Gamma (0.01,0.02)	0.0018 (0.0002)
<i>Taylor rule</i>			
$\gamma_{\pi} - 1$	Coefficient on inflation	Inverse Gamma (0.5,0.5)	0.1278 (0.0186)
γ_y	Coefficient on output	Normal (0.5,0.1)	0.6156 (0.0756)
γ_R	Smoothing parameter	Beta (0.8,0.05)	0.9159 (0.0133)
Note : (a) Priors: shape (prior mean, prior standard deviation). (b) Gaussian approximation of posterior standard deviation at the mode are given in parentheses.			

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 fair 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 externalities. 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.

Figure 1: Inflation dynamics across policy regimes

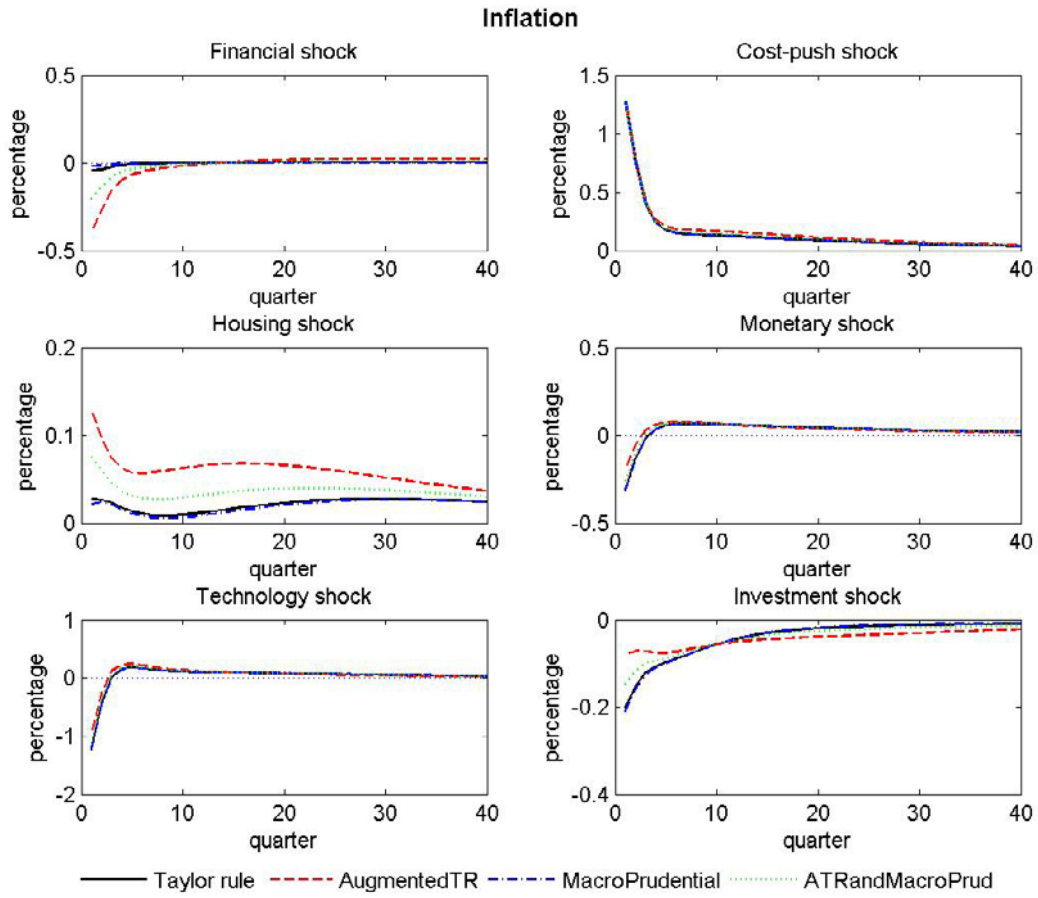


Figure 2: Effects of a financial shock (credit supply) across policy regimes

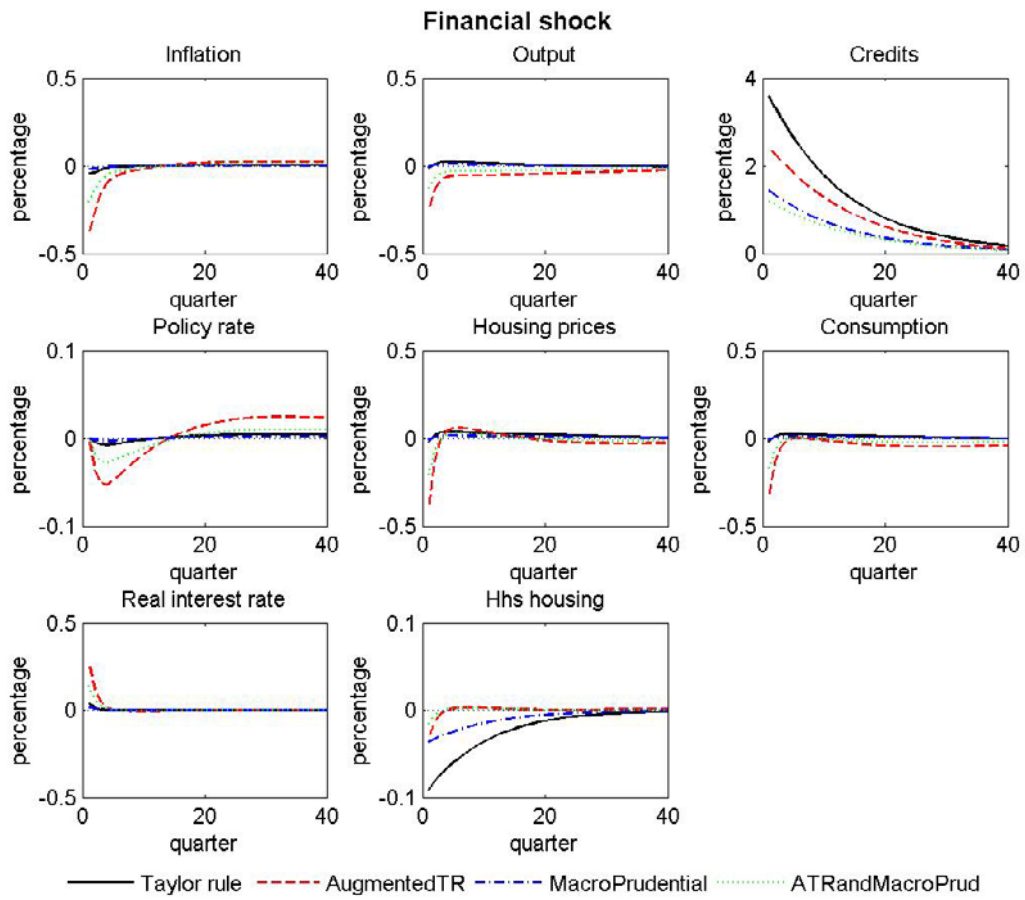


Figure 3: Effects of a productivity shock across policy regimes

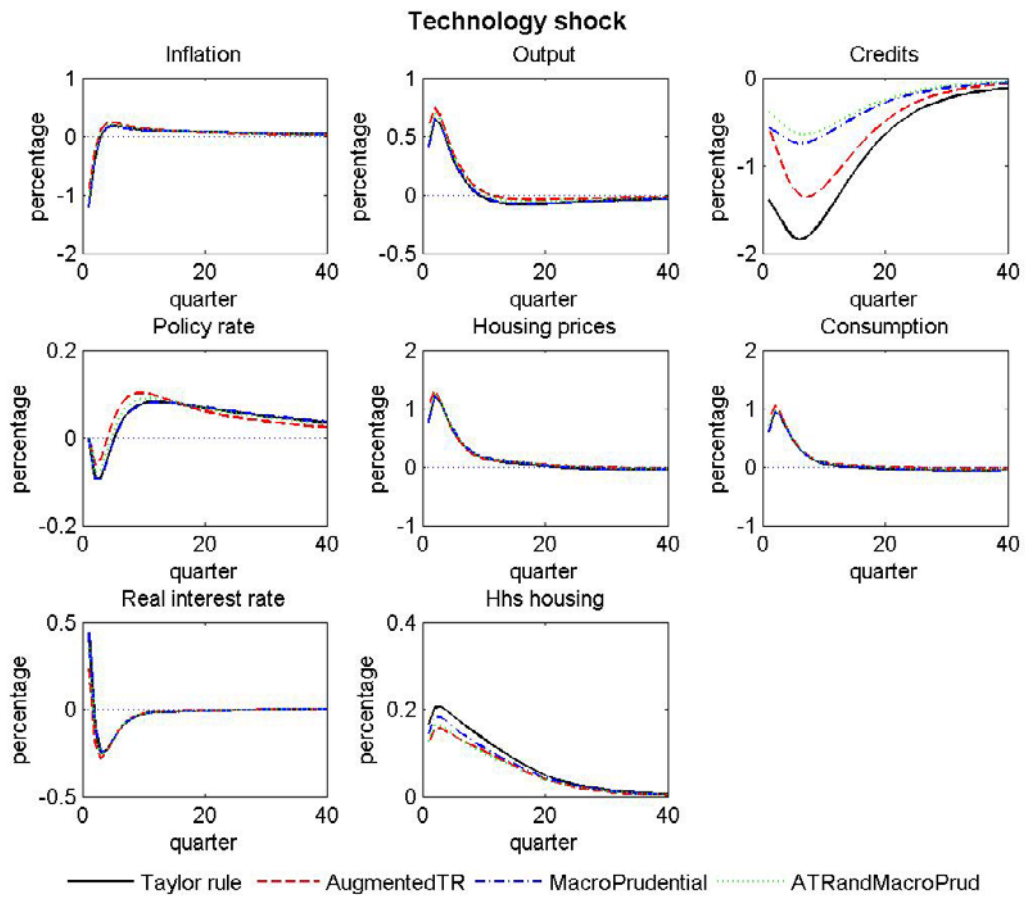


Figure 4: Effects of a monetary policy shock across policy regimes

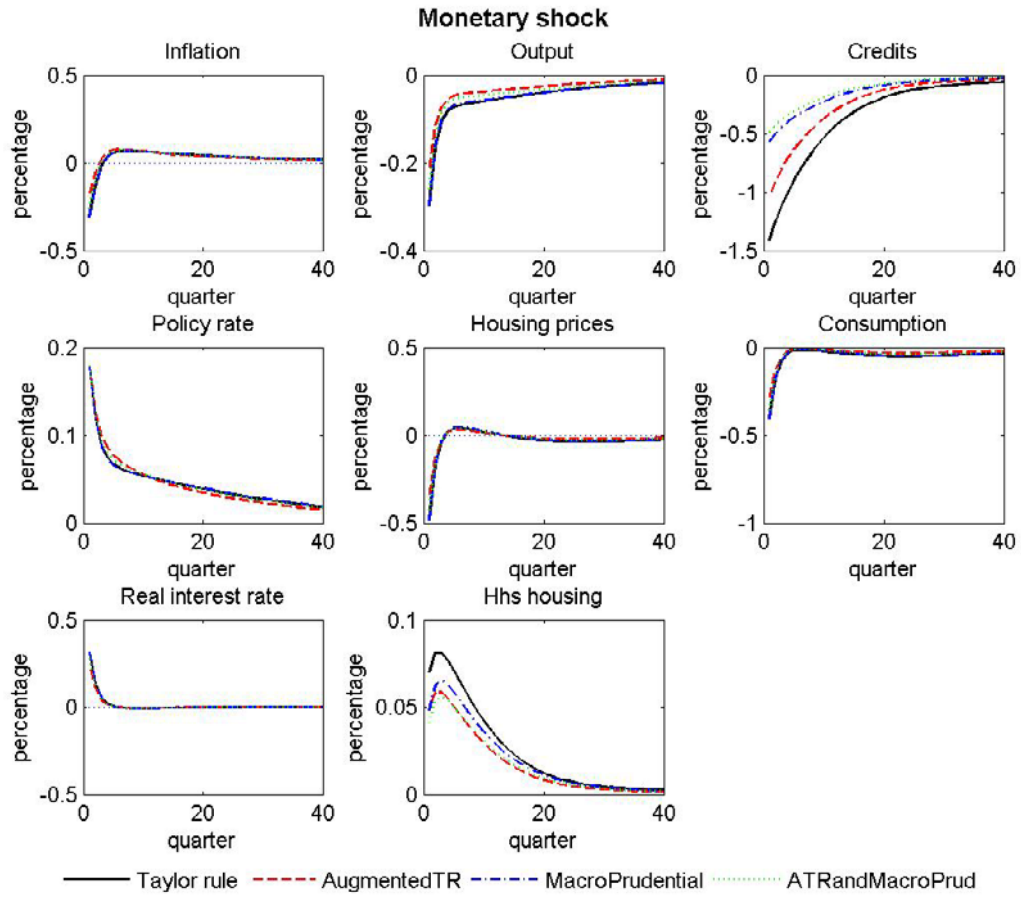
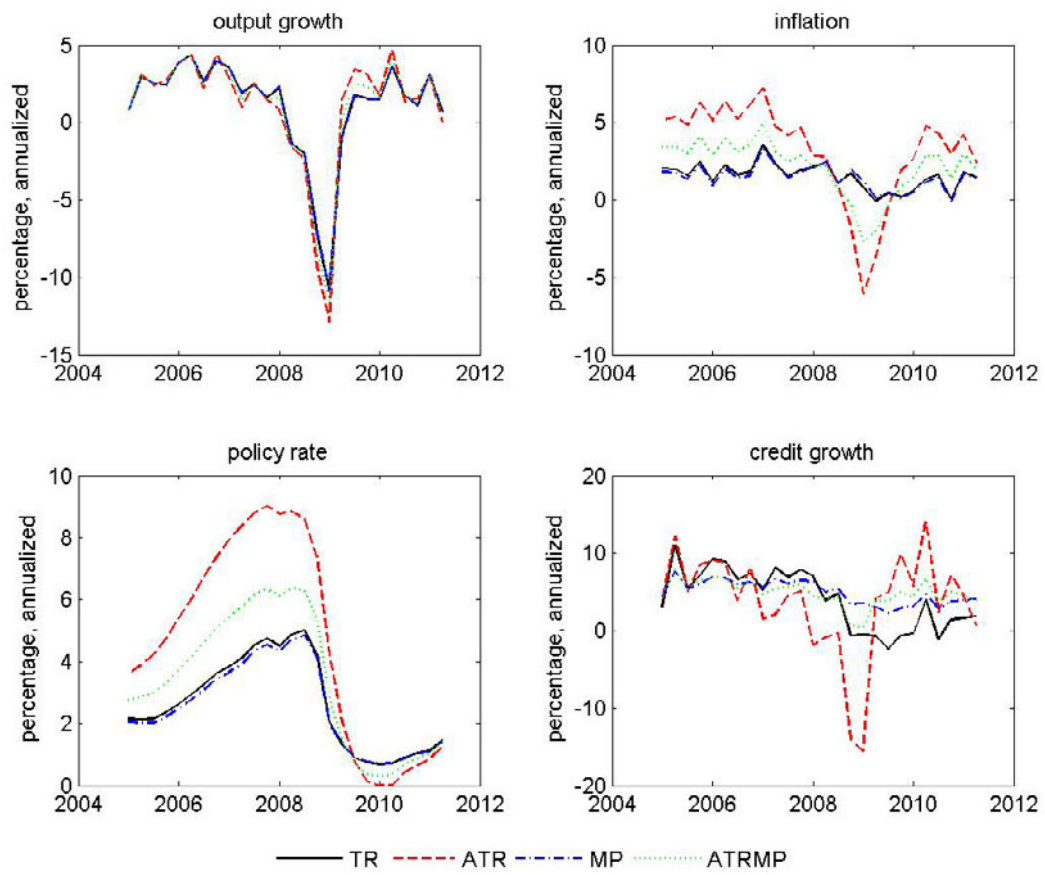


Figure 5: Counterfactual on macro-prudential policies



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