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## Proceedings

# New challenges in central banking: Monetary policy governance and macroprudential issues

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# New Challenges in Central Banking: Monetary Policy Governance and Macroprudential Issues

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**New Challenges in Central Banking:  
Monetary Policy Governance and Macroprudential Issues**

# NEW CHALLENGES IN CENTRAL BANKING: MONETARY POLICY GOVERNANCE AND MACROPRUDENTIAL ISSUES

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# 1. NEW CHALLENGES IN CENTRAL BANKING: MONETARY POLICY GOVERNANCE AND MACROPRUDENTIAL POLICY ISSUES – INTRODUCTION

*Ernest Gnan and Donato Masciandaro*

*Which are the new frontiers in central banking? Which things have changed in the aftermath of the financial, economic and sovereign debt crisis? These are questions raised frequently by central bankers, academics and interested observers alike. There are quite a few areas to cover in answering these questions. The aim of the workshop organized jointly between SUERF and the Baffi Carefin Centre of Bocconi University in Milan on 8 June 2017 was to focus on two areas: monetary policy committees, on the one hand, and new prudential responsibilities, on the other hand. This chapter summarizes the findings from the workshop. Not all papers are included in this volume.*



Donato MASCIANDARO, President BAFFI CAREFIN Centre, Bocconi University and SUERF, and Urs W. BIRCHLER, SUERF President and University of Zurich, opened the conference emphasising the importance of bringing together academic research and practitioners' views, in order to gain relevant insights in the field.

The keynote speech was given by Athanasios ORPHANIDES, MIT Sloan School of Management on the topic of “ECB monetary policy and euro area governance: collateral eligibility criteria for sovereign debt”. He started out by arguing that risk spreads and credit ratings on various countries' sovereign bonds had little to do with debt to GDP levels and thus debt sustainability. A key feature of the euro area crisis in his view was the compromising of most euro area countries' safe asset status. Before the euro, eligibility of government debt by the various NCBs as collateral for monetary policy operations was beyond questioning. With the start of the euro, the ECB used private credit ratings to determine collateral eligibility of a large number of private assets. After the softening of the Stability and Growth Pact by Germany and France in 2014, the ECB was criticized for differentiating insufficiently between various governments' debt and was encouraged to exert fiscal discipline. In November 2015, the ECB communicated that eligibility of government debt was subject to a credit rating threshold. However, during a crisis, credit ratings based eligibility thresholds can become destabilizing: Fears of downgrades and potential default become self-fulfilling if investors

expect that the ECB might refuse to accept government debt as collateral. Thus, reliance on credit ratings unintentionally guides markets to an adverse expectational equilibrium for sovereign with more fragile fundamentals. The resulting safe haven portfolio shift from weak to strong governments in Orphanides' view induces an indirect fiscal transfer in the form of risk premium differentials. While the November 2015 decision initially entailed no market effects, the cliff effect resulting from it showed in spring 2010, when rating agencies downgraded Greece below the ECB threshold. The ECB suspended its collateral rules but only after the Greek government accepted conditions set by other member states. As a result, the ECB's collateral framework de facto became a disciplining device against affected euro area governments. It would not be imaginable in e.g. the US or Japan that the corresponding national central bank adopts collateral rules aiming to discipline their respective governments.

Furthermore, in October 2010, France and Germany agreed that whenever a euro area member state faced difficulties, losses on private creditors would be demanded. This agreement relied crucially on the ECB's collateral framework to be used as a threat against weak governments. As a result, sovereign debt of weak governments lost its status as a safe asset for private investors; the central bank no longer served as a backstop for governments and against adverse self-fulfilling expectational equilibriums. This in turn reduced fiscal scope for weak countries, reducing governments' ability to cushion negative shocks. A reason often put forward in favour of using the collateral framework as a disciplinary device for governments is moral hazard, in the sense that extremely low interest rates would reduce governments' willingness to embark on reforms. In Orphanides' view, with such collateral policy, the ECB exceeds its mandate. The ECB should thus reconsider its collateral policy and perform its own independent debt sustainability assessment, without including unjustified default fears in its analysis. Enforcement of the EU's fiscal rules should be left to the European Commission and the member states, in accordance with the Treaty; the ECB should in turn confine itself to its mandate.

**Session I**, chaired by Sylvester EIJFFINGER, Tilburg University, CESifo and CEPR, was devoted to monetary policy governance. The first paper by Sylvester EIJFFINGER and Louis RAES, Tilburg University, was entitled "Estimating the Preferences of Central Bankers: an Analysis of four Voting Records". The results presented were results of an ongoing research agenda covering various central banks, with this presentation focusing on the Czech National Bank. Recent research has paid attention to the influence of the design and composition (internal versus external members, appointment procedures, gender, regional representation, etc.) of central bank decision-making committees on monetary policy decisions. Using ideal point models, the authors first estimate latent prefer-

ences of the Czech National Bank's central bank committee members and rank them according to their dovishness versus hawkishness on a latent scale. Using data between 1998 and 2017, they tend to confirm earlier empirical results that women tend to be more hawkish; governors are either found to be rather neutral or very dovish. Their research on various central banks so far does not allow any generalized conclusions; every central bank needs to be treated as an individual case study.

The second paper by Alessandro RIBONI, École Polytechnique, Paris, and Francisco RUGE-MURCIA, McGill University, dealt with "Deliberation in Monetary Policy Committees". The authors analyse a model of communication and voting within a monetary policy committee and check whether the predictions made by the model match FOMC voting data. In particular, they are interested to what extent FOMC members change their view following the discussion and decision-making procedure (measured as the difference between final votes and views expressed before). They find that deliberation in committees partially reveals individual members' ability (or lack thereof) and private signals. Absence of mind changes of individual members' does not necessarily signal ability, in the sense that a person sticking to her gun may appear smarter. On the contrary, low-skilled members may try to conceal a contrarian signal and take a conservative stance, while smart members may be less afraid to share a contrarian signal, putting it on the table for an open discussion; thus smart members might even appear less consistent.

The third paper by Donato MASCIANDARO, Bocconi University and SUERF, Paola PROFETA, Bocconi University, and Davide ROMELLI, Trinity College Dublin, was entitled "Behavioural Monetary Policymaking and Gender: Theory, Institutions and Empirics". The paper starts from the observation that women continue to be under-represented in many industries and professions, including executive positions in money and finance. The authors raise the question whether in monetary policy, increased gender diversity might change decision-making, e.g. because of gender-related differences in risk aversion, loss aversion or "conservativeness", or simply because gender diversity adds to committees' diversity of views. The paper offers innovations in theory, metrics (first index of gender diversity in monetary policy-making for the period 2002-2015 in 37 countries) and empirics (cross-section analysis of drivers and effects of gender diversity in monetary policy committees). Based on various data sources, they first show that over time, in the sample of 37 countries, the share of women strongly increased from below 10% to 14% between 2002 and 2005, then fell back to just over 10% until 2010, and rose again to 14% by the end of the sample in 2015. In 2015, the female share was 15% for a larger sample of 112 countries. The evolution of the share of female deputy governors followed a similar but more volatile pattern, rising from below 5% in 2002 to above 11% by 2015. The share of central bank

boards with two or more females increased from 10% in 2002 to 30% by 2015; however, a little less than 50% of central bank boards continue to have no female member at all in 2015. The share of women over the past decade has mostly increased in those central banks, where representation was already higher. North America and Africa as well as low-income countries have the highest share of women on central bank boards. Preliminary econometric estimates indicate that gender representation on monetary policy boards is influenced by country and institutional factors, such as staff gender ratio, country gender equality and central bank independence. Female representation can affect monetary policy-making: a higher female share according to preliminary estimates seems to be associated with more hawkish monetary policy decisions.

**Session II**, chaired by Ernest GNAN, SUERF Secretary General and Oesterreichische Nationalbank, addressed macro-prudential policy from theoretical, institutional and empirical viewpoints. The first paper by Anil KASHYAP, University of Chicago, Dimitrios TSOMOCOS, University of Oxford, and Alexandros VARDOULAKIS, Federal Reserve Board, dealt with “Optimal Bank Regulation in the Presence of Credit and Run Risk”. The authors extend the Diamond-Dybvig (1983) model to study externalities emerging from intermediation, and how regulation can mitigate their effect. They find that all the types of regulation they investigate reduce the probability of runs, thus raising welfare for businesses and savers. The probability of a run due to bad fundamentals falls but does not vanish. Bankers are worse off because regulation does not allow them to take full advantage of limited liability. Different types of regulation (capital and leverage versus liquidity regulations) have different effects on investment and credit risk. Capital and liquidity ratios can be combined to usefully complement each other. Liquidity ratios are useful for dealing with liquidity risk but not credit risk. Capital regulations are useful for addressing credit risk but also the risk of bank runs. Net stable funding regulation is useful for addressing both liquidity and credit risks but is hard to combine with other forms of regulation. There are at least three different types of margin distortions in private banking decisions. Thus, there is need for at least three separate tools to address all these externalities. But it needs to be ensured that these tools are jointly binding.

The second paper by Eugenio CERUTTI, International Monetary Fund, Stijn CLAESSENS (BIS) and Luc LAEVEN (ECB) provided evidence on the use and effectiveness of macro-prudential policies, based on a series of papers prepared by the authors. A first study published in 2015 covered 119 countries for the period 2000-2013 and considered 12 different macro-prudential measures: loan-to-value caps, debt-to-income ratios, time-varying loan-loss provisioning, counter-cyclical requirements, leverage ratios, capital surcharges on systemically important financial institutions, limits on interbank exposures, concentration

limits, limits on foreign lending, reserve requirements, credit growth caps, and levies or taxes on financial institutions. They found that over time the use of macro-prudential measures increased markedly, less so in advanced economies than in emerging market and developing nations. Advanced economies use more borrower-based, emerging economies a broad set of macro-prudential tools. Regressions show significant and large effects of macro-prudential tools (measured by a summary index) on credit. The effect is stronger in emerging than in advanced economies, the measures are less effective in open economies, pointing to possible circumvention, which is also confirmed by a positive correlation between the use of macro-prudential tools and cross-border activities. Furthermore, they find macro-prudential tools to have less impact on credit in countries with more developed financial systems and with flexible exchange rates. Macro-prudential tools are found to be more effective when credit growth is high. The effect of macro-prudential tools is furthermore found to be asymmetric for upswings versus downswings. A further study from 2017 covered 64 countries for the period 2000-2014, investigating usage intensity of five types of prudential instruments. The study finds that reserve requirements and loan-to-value caps are adjusted most often, while interbank exposure limits and concentration limits were not often adjusted. Capital requirements were tightened especially after the global financial crisis. Loan-to-value ratios were raised often after the financial crisis, counteracting loose monetary policies in several countries. Loan-to-value ratios and reserve requirements were used more systematically in a counter-cyclical fashion than other types of instruments. Overall, experience with macro-prudential measures is still at an early stage. More research and experience with respect to interactions with other policy areas, on side effects and costs, on political economy aspects and on rule-based versus discretionary application are needed.

The third paper by David MARTINEZ-MIERA, Carlos III University, Madrid and CEPR, and Eva SCHLIEPHAKE (University of Bonn and Harvard) dealt with the topic of “Bank Capital Regulation with Unregulated Competitors”. The authors analyse optimal bank regulation in a model where regulated banks are confronted with competition from unregulated institutions. They find that, contrary to common wisdom, an increase in competition from unregulated entities can result in a decrease of social welfare if the level of competition in the banking market is high enough. To limit this loss of welfare, bank regulators should reduce capital regulation. On the other hand, if the level of competition among banks is low, an increase in competition from unregulated entities leads to higher optimal capital requirements and results in higher welfare. These non-monotonic results highlight the need of a better understanding of the underlying trade-offs regarding bank capital regulation, regulatory arbitrage and social welfare.

**Session III**, chaired by Tommaso MONACELLI, Bocconi University, studied how monetary policy and macro-prudential policies are modelled in new DSGE models. The first paper by Margarita RUBIO, University of Nottingham, and Fang YAO, Reserve Bank of New Zealand, focused on macro-prudential policies in a low interest-rate environment. Post-crisis economies are characterised by very low neutral interest rates. These, on the one hand, limit the scope for conventional monetary policy to stimulate the economy while, on the other hand, raising concerns about financial imbalances and future financial instability. Using a calibrated DSGE model, the authors investigate the consequences for business and financial cycles of a steady-state interest rates falling from 4% to 2%. They find that in such a low-equilibrium interest rate environment, the zero lower bound becomes binding more frequently, leading to greater macroeconomic volatility and financial instability. In this environment, the case for macro-prudential tools becomes stronger as they may either be used to contain financial imbalances arising from ultra-low interest rates or to complement monetary policy when conventional monetary policy instruments are constrained. In a low interest environment, macro-prudential policies need to be more aggressive in responding to credit.

The second paper by Seraffín FRACHE, Jorge PONCE, Banco Central de Uruguay, and Javier GARCÍA-CICCO, Banco Central de Chile, elaborated on “Monetary and Prudential Policies in a DSGE Setting”. They estimate a DSGE model of a small-open economy with a banking sector and endogenous loan default with data for Uruguay, as characterized by a dollarized banking system and by dynamic provisions since 2001. They find that counter-cyclical buffers and dynamic provisions are effective in generating buffers that may cover future losses. It is unclear whether they have counter-cyclical real-economic effects or not. The source of the shock is important, as it matters to select the optimal policy tool: dynamic provisioning seems to outperform counter-cyclical buffers in the event of external financial shocks. For dynamic provisioning, the same calibration may be excessively counter-cyclical if the shock is domestic instead of external.

The third paper by Dmitriy SERGEYEV, Bocconi University, was devoted to “Countercyclical prudential tools in an estimated DSGE model”. The author solves for optimal macro-prudential and monetary policies for members of a currency union in an open economy model with nominal price rigidities, demand for safe assets, and collateral constraints. As is the case in EMU, monetary policy is conducted by a single central bank, which sets a common interest rate, while macro-prudential policies are set at a country level through the choice of reserve requirements. Two main results emerge. First, with asymmetric countries and sticky prices, the optimal macro-prudential policy has a country-specific stabilization role beyond optimal regulation of financial sectors. This result holds even if optimal fiscal transfers are allowed among the union members. Second, there is



a role for global coordination of country-specific macro-prudential policies. These results call for coordinated macro-prudential policies that go beyond achieving financial stability objectives.

The final paper by Daniel COHEN, Mathilde VIENNOT, Paris School of Economics, and Sébastien VILLEMOT (OFCE-SciencePo) was entitled “Schäuble versus Tsipras: a New-Keynesian DSGE model for the Eurozone Debt Crisis”. The authors calibrate a New-Keynesian DSGE model to show that consumption habit persistence (which makes adjustment after a large GDP shock painful and the shock more persistent) plays an important role in determining default probabilities and debt levels. The authors compare three frameworks: a flexible exchange rate case, a “Schäuble” case (country leaves the monetary union if it defaults) and a “Tsipras” case (country stays in the monetary union even if it defaults). They formulate a “Schäuble theorem”: provided habit formation is sufficiently high (i.e. adjustment is painful), if you give a country in a monetary union the choice between a) default and leaving the zone and b) default and staying in the zone, the country will always choose the latter option. From a monetary union policy maker’s point of view, one should not offer the choice and impose the first option. This result is, however, reversed in case of low habit persistence.

As usual with SUERF’s events, the workshop managed to translate technical academic research into useful insights for practical and policy purposes. The workshops also showed that these are fields where more research and practical experience will need to be gathered in the years to come.

## 2. ECB MONETARY POLICY AND EURO AREA GOVERNANCE: COLLATERAL ELIGIBILITY CRITERIA FOR SOVEREIGN DEBT

*Athanasios Orphanides*<sup>1</sup>

### 2.1. INTRODUCTION

A key feature of the euro area crisis has been the compromising of the safe asset status of the government debt of most member states. Whereas before the crisis government debt of euro area member states was considered safe, as in all other advanced economies, fear of default has become a feature of most euro area government bond markets since the crisis started. Euro area governments have experienced greater fiscal stress than governments of advanced economies outside the euro area with weaker fiscal fundamentals.<sup>2</sup> This paper examines the role of the European Central Bank (ECB) in generating this fragility and discusses how it can be corrected.

The fragility can be traced to a discretionary decision taken by the ECB Governing Council following the demise of the Stability and Growth Pact (SGP) in 2005. The SGP was supposed to ensure fiscal discipline by euro area governments – a prerequisite for the functioning of the monetary union. The SGP demise created a predicament for the ECB. Once it became clear that the fiscal rules could not be enforced, an alternative mechanism was required to ensure fiscal soundness. The operational framework adopted by the ECB with the introduction of the euro blunted the potential role of market discipline. Changes in this framework could encourage market forces to replace the disciplining role of the SGP. In this light, the ECB decided to modify its collateral framework and explicitly link collateral eligibility of government debt to private credit ratings. The decision facilitated a role for market discipline by effectively turning the ECB's collateral framework into a disciplining device for euro area governments. Leveraging the role of market discipline through its collateral eligibility framework led to the compromising of the safe asset status of government debt for most euro area member states during the crisis. In this manner, the ECB

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<sup>1</sup> This paper is based on the author's presentation at the SUERF/BAFFI CAREFIN Centre Conference on New Challenges in Central Banking: Monetary Policy Governance and Macroprudential Issues, held at Bocconi University in Milan on 8 June 2017. I would like to thank conference participants as well as participants of presentations at Harvard University and Yale University for helpful discussions and comments. Correspondence: MIT Sloan School of Management, E62-481, 100 Main Street, Cambridge, MA 02142. Tel.: +1-617-324-4051. E-mail: athanasios.orphanides@mit.edu.

<sup>2</sup> See De Grauwe (2011), Orphanides (2017b) and references therein.

inadvertently planted the seeds of the euro crisis and the continuing fragility in euro area government bond markets.

The ECB's decision to use its collateral framework as a disciplining device could be seen as an attempt to address moral hazard. Validating default fears by denying collateral eligibility during a financial panic can be a potent tool to punish fiscal laxity. However, in light of the multiplicity of self-fulfilling equilibria in sovereign markets, this method of addressing the governance shortfalls of the monetary union comes at a considerable cost: It coordinates market expectations towards adverse outcomes for "weaker" member states and induces an indirect fiscal transfer in the cost of financing of government debt from "weaker" member states to "stronger" member states. The indirect transfer takes the form of an unnecessary risk premium on the government debt of "weaker" member states and a corresponding safe haven subsidy for "stronger" governments.

This paper examines how the ECB inadvertently planted the seeds of the euro crisis and discusses how the resulting tensions can be reversed. Following a brief overview of the governance of the euro area as envisioned in the Maastricht framework, the paper revisits the demise of the SGP to put in context the resulting ECB predicament. The paper subsequently reviews the ECB collateral framework, examines the role of credit ratings, and discusses the transformation of the framework into a disciplining device that could be employed against "misbehaving" governments of member states. It then explains the destabilizing consequences of the cliff effect induced by the ECB in the government bond markets of weaker member states. The paper concludes with a discussion regarding the legitimacy of using the ECB collateral framework as a disciplining device and a proposal on how the ECB could modify its procedures and contribute towards ameliorating the ongoing fragility in the euro area, in accordance with its mandate.

## 2.2. THE MAASTRICHT FRAMEWORK

The success of an economic and monetary union requires a framework that can ensure sound fiscal policies by the governments of member states and a stability-oriented monetary policy by the common central bank. To understand the inherent tensions that have confounded policy during the crisis, it is useful to review the basic interactions of monetary and fiscal policy in the Maastricht framework and the division of labor between the governments, the ECB and other institutions for ensuring the proper functioning of the monetary union.

European countries that joined the euro area relinquished monetary sovereignty to a common central bank created to act in the interest of the euro area as a

whole. The ECB, the common central bank created by the Maastricht Treaty was to be powerful and independent with vast discretionary power to control monetary policy over the euro area as a whole but also a narrow primary mandate: Price stability. Without prejudice to price stability, the Treaty also instructed the ECB to contribute to all other objectives of the European Union and the wellbeing of its citizens. To ensure that the ECB would be protected from fiscal dominance and be able to maintain price stability over time, the Treaty prohibited the ECB from engaging in monetary financing of the governments of the member states.

Fiscal policy remained the domain of individual member states. A concern before the adoption of the euro was the deficit bias that typically arises in democratic societies: Elected governments may have an incentive to engage in overspending to enjoy short-term political benefits without taking sufficiently into account the cost imposed by high debt levels on future generations. In a monetary union, such overspending would have negative spillovers to other member states and could potentially compromise the stability of the common currency. To ensure that individual member states would not engage in unsustainable overspending, strict rules on debts and deficits were adopted to discourage profligacy – the Stability and Growth Pact (SGP). The SGP was adopted in 1997 – after the Maastricht Treaty but before the introduction of the euro – in order to strengthen the fiscal framework outlined in the Treaty by specifying detailed rules and procedures for fiscal surveillance. It required governments to contain fiscal deficits to be at most 3% of GDP and work towards keeping government debt below 60% of GDP over time.

The enforcement of the rules and monitoring of member states was to be coordinated by the European Commission (EC) in its capacity as the guardian of the Treaty. Similar to the ECB, the EC was meant to be an independent institution, with the authority to make recommendations to the governments of the member states on issues of common interest, including regarding the application of sanctions on the government of any member state in case the mutually agreed framework was not respected by that government. According to the Treaty, the EC Commission has the exclusive right of initiative to submit recommendations for actions by the governments and has the obligation to exercise this right in a manner that facilitates the effective functioning of the SGP and the monetary union. The ultimate responsibility for enforcing the SGP was left to the governments – specifically the ECOFIN Council which is composed of the Finance Ministers of the member states.

### 2.3. THE DEMISE OF THE SGP

Soon after the creation of the euro, the Maastricht framework failed.<sup>3</sup> Faced with slow growth, in 2002-2003 the German government decided that it was not in the interest of Germany to respect the deficit limits of the SGP. The weak economy called for more expansionary fiscal policy and a larger fiscal deficit. The SGP was easy to criticize as too inflexible and inconsistent with traditional Keynesian macroeconomic stabilization principles. Given the choice between respecting the strict deficit limits of the SGP and pursuing what would have otherwise been seen as desirable countercyclical fiscal policy, the German government decided to violate the rules.

Recognizing the risk of compromising one of the building blocks of the monetary union, the EC objected to the violation. However, it was ignored. Instead, the German government approached the French government, which had also expressed a desire to allow for more accommodative fiscal policy. The French government decided to follow Germany and embrace a larger fiscal deficit than allowed by the SGP and together the two governments worked towards relaxing the framework for all. In November 2003, the French and German governments successfully demonstrated that they could block the enforcement of the SGP, rendering it meaningless. EU governments decided to reject the EC recommendations to move towards sanctioning the French and German governments. Subsequent to that decision, a formal process to change the rules was initiated which was concluded in 2005.

On 20 March 2005, the ECOFIN Council reached an agreement on reforming the SGP. An attempt was made to describe the reform as an improvement but it was widely acknowledged that this was less than accurate. As Buiters (2006) observed: “The reforms of the Pact adopted in March 2005 effectively killed it” (p. 2). Having agreed to the relaxation of the rules proposed by the French and German governments, the governments of many other member states adopted a more relaxed attitude towards fiscal discipline, thereby confirming the failure of the Maastricht framework.

### 2.4. THE ECB CHALLENGE

Recognizing the threat to the success of the monetary union, the ECB expressed serious concerns about the changes in the framework. In a statement on 21 March 2005 – the day after the ECOFIN had reached its decision to weaken the SGP – the ECB Governing Council explained:

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<sup>3</sup> See Buti et al (2003), Eijffinger (2005), Buiters (2006) and Schuknecht et al (2011) for analyses of the challenges. Ioannou and Stracca (2011) document the pervasiveness of the failure.

*“Sound fiscal policies and a monetary policy geared to price stability are fundamental for the success of Economic and Monetary Union. They are prerequisites for macroeconomic stability, growth and cohesion in the euro area. It is imperative that Member States, the European Commission and the Council of the European Union implement the revised framework in a rigorous and consistent manner conducive to prudent fiscal policies.*

*More than ever, in the present circumstances, it is essential that all parties concerned fulfil their respective responsibilities. The public and the markets can trust that the Governing Council remains firmly committed to deliver on its mandate of maintaining price stability.” (ECB, 2005b.)*

By reminding the governments that they ought to “fulfil their respective responsibilities” the ECB was attempting to convince the governments to maintain a rules-based framework for ensuring fiscal discipline in the euro area. The ECB efforts did not bear fruit.

Following the decision of the governments to abandon the mechanism that was supposed to ensure fiscal discipline over time, the ECB could no longer be certain that governments could be trusted to maintain sound fiscal finances going forward. In the absence of an effective, rules-based framework to ensure fiscal soundness, financial markets would have to serve the role of discouraging member state governments from the temptation to run excessive deficits. If fear of default on government debt could be cultivated in financial markets whenever governments with high debt run excessive deficits, holders of government debt would demand an additional credit premium. This mechanism would unnecessarily raise the cost of debt finance for governments, and thus be inefficient. However, it would also discourage fiscal profligacy. In effect, in light of the failure of the SGP, market discipline could potentially replace the SGP’s role as a mechanism for securing fiscal soundness in the monetary union.

At the heart of central banking are lending operations. The central bank can lend money to financial institutions that present to the central bank assets that can be posted as collateral in exchange for the loan. The determination of which counterparties have access to central bank lending operations, what assets constitute eligible collateral, and the terms of the loan, are critical decisions that depend on the limits and use of discretion by the central bank and can vary depending on the institutional setting and legal environment governing the operations of the central bank.

The operational framework adopted by the ECB with the introduction of the euro blunted the potential role of market discipline. Similar to the treatment of government debt issued by their governments in any other central bank, the ECB accepted the government debt of all euro area member states as eligible collateral

for credit operations. Financial institutions holding the debt of any euro area government could obtain liquidity from the ECB to finance their holdings by posting the debt as collateral. This ruled out the possibility of liquidity pressures on any euro area government and, since the SGP assured long-term debt sustainability, there was virtually no market discrimination among the government debt of euro area member states. The government debt of all euro area member states was considered a safe asset. This was desirable and appropriate as long as the SGP could be trusted to function effectively. It was also necessary to ensure consistency with the favorable treatment of government debt that had been hardcoded in the regulation of banks and pension funds.<sup>4</sup>

Article 18 of the Statute governing the ECB authorizes the institution to conduct credit operations “with lending being based on adequate collateral.” The determination of what constitutes “adequate” collateral is left to the discretion of the ECB Governing Council. When the euro was created, the eligibility of government debt was beyond questioning: It was inconceivable that the ECB would use its discretion to declare that the government debt of a member state was not “adequate” collateral, absent extreme circumstances that rendered that states’ debt unsustainable. The ECB also decided to accept private assets as eligible collateral, provided that these assets met “high credit standards.” Since the list of eligible collateral included tens of thousands of private assets, the ECB took into account available ratings by private credit rating agencies in its assessment of these assets. By declaring some private assets, but not others, eligible collateral, the ECB powerfully demonstrated its discretion in determining the meaning of “adequate” collateral in its credit operations.

The challenge for the ECB was how to interpret its obligations and its discretionary powers regarding the treatment of government bonds of euro area member states. Following the failure of the SGP, part of the challenge became how to take into account concerns about moral hazard, in the wider context of the governance of the euro area.

## 2.5. MARKET DISCIPLINE AND THE ECB COLLATERAL FRAMEWORK

In the context of the demise of the SGP in March 2005, the ECB faced criticism for not using the discretionary power relating to its monetary policy in a manner that would leverage market discipline. Several commentators observed that the

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<sup>4</sup> In their formulation of the regulatory framework for banks and pension funds, as reflected in European Union Directives, euro area governments had decided to treat the euro denominated government debt of all member states as a safe asset.

operational framework of the ECB did not differentiate sufficiently among the government debt of member states which compressed spreads, further diluting the potential discipline market forces might provide.<sup>5</sup> Given the failure of the SGP, the ECB was encouraged to change its operating procedures to allow for greater differentiation. At the center of the debate was the ECB's discretionary authority to change its collateral framework in a manner that would induce greater market-based fiscal discipline.

At the press conference following the 7 April 2005 meeting of the ECB Governing Council, President Trichet was asked to comment on the view that the ECB framework hindered the market instead of helping the market "reward sound public finances and punish unsound finances." In his response, Trichet reiterated that it was imperative to restore the SGP's credibility and stressed that "every institution has to be up to its responsibility, and this is truer than ever." With respect to the ECB's collateral framework he noted that "... it is not the intention of the Governing Council of the ECB to change our framework now." (ECB, 2005c.)

The issue was followed up a few weeks later, in speeches by ECB Executive Board Member Otmar Issing on 20 May 2005 and by ECB Vice President Lucas Papademos on 3 June 2005. Issing noted that proposals had been made to use the ECB's collateral framework "as a sanction to exert fiscal discipline" but while acknowledging that the suggestion was "superficially appealing" he characterized the suggestion "misguided." He also noted: "[S]uch a measure would exceed the mandate of ECB's collateral policy, which is to manage risk in monetary policy operations. Assigning additional roles to collateral policy would deflect it from its primary and crucial purpose." (Issing, 2005.)

Along similar lines, Papademos addressed whether financial markets could help encourage fiscal discipline observing that, with the exception of financial crises, markets did not appear to reward fiscal prudence and punish unsustainable fiscal policies to a great extent. He went on to note: "[I]t has been suggested that the ECB's collateral policy could encourage market reactions to fiscal policies, for example, by imposing haircuts for bonds issued by governments that fail to comply with the SGP." While also acknowledging that these suggestions might appear "appealing at first glance," he indicated he did not find the arguments convincing and concluded: "The purpose of the ECB's collateral policy is to ensure sufficient availability of collateral to allow a smooth implementation of monetary policy and to protect the Eurosystem in its financial operations. Using the framework for alternative purposes would be contrary to the ECB's mandate." (Papademos, 2005.)

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<sup>5</sup> See e.g. Buitert and Sibert (2005), de la Dehesa (2005) and Ullrich (2006).



As 2005 progressed, the consequences of weakening the SGP on fiscal finances became increasingly evident. About half the member states run afoul of the rules and the criticism directed at the ECB for not using its collateral framework as a disciplining device continued.

An article published in the ECB Monthly Bulletin in August 2005 on the “Reform of the Stability and Growth Pact,” suggested a change in tone. The article reviewed the reasons why it was critical to constrain fiscal policy with simple, enforceable rules, noting their particular significance in a monetary union and also the interaction with markets:

*“In a monetary union among sovereign states, the deficit bias of fiscal policy is likely to be exacerbated. The adoption of a common currency eliminates the exchange rate risk and the associated interest rate risk premia among the participant countries, thus blunting the discipline normally exerted by financial markets on governments’ fiscal behaviour. As national financial markets become more integrated, sovereign issuers can draw on a larger and more liquid currency area-wide capital market.”*

The article also suggested concerns regarding compliance with the rules in the reformed SGP:

*“A source of uncertainty pertains to the impact of the reform on compliance. . . . the relative complexity of the rules, the relaxed standards for determining the existence of an excessive deficit and the more remote prospect of sanctions are liable to reduce the reputation cost of unsound fiscal policies. Moreover, the increased complexity of the rules may also have implications for the monitoring of fiscal policies by financial markets and the general public.”* (ECB, 2005d, p. 71-72)

In early November 2005, the ECB communicated a drastic change to its collateral framework. Collateral eligibility for all assets, including government debt, would be subject to a minimum credit rating threshold. The change was first reported online in the Financial Times on 8 November and published in the following morning’s print edition of the newspaper. According to the article:

*“In an attempt by the ECB to warn European governments about the consequences of overspending, the bank is to state that it will only accept bonds with at least a single A- rating from one or more of the main rating agencies as collateral in its financial market activities, European Union financial policy-makers said.*

...

*EU government officials said the ECB had discussed its collateral strategy in meetings with eurozone finance ministers. A formal announcement is expected soon.*

...

*The ECB refused to comment on its plans. The Frankfurt-based institute is likely to explain the move as part of efforts to increase transparency. It has faced claims that it could do more to put pressure on governments breaking EU rules on public sector deficits and debt levels.” (Atkins and Schieritz, 2005).*

The article noted that the ECB refused to comment on its plans but this changed with the article’s publication. At a press conference in Frankfurt on 9 November, ECB President Trichet attempted to downplay the significance of the change in the collateral eligibility criteria for government debt. According to Agence France-Presse (2005), he stated:

*“I confirm that we have a policy to accept collateral ... at a rating threshold of single-A ... That's what we've been doing since the launch of the euro in 1999. Since 1999 we had never taken collaterals below this rating threshold.”*

Despite this communication, the announcement that the ECB was prepared to deny collateral eligibility to government bonds on the basis of the assessments of private credit ratings was read very differently than Trichet’s interpretation that the collateral framework had not been modified. Instead, the explicit and automatic reliance on credit rating agencies was recognized as the ECB’s response to the weakening of the SGP. It was also read as a decision indicating the ECB’s willingness to use the discretionary authority relating to its collateral framework as a disciplining device against member states governments. The reporting in the Financial Times (2005) was characteristic:<sup>6</sup>

*“The ECB believes fiscal discipline is vital for the proper functioning of monetary union, but is concerned over how rigorously it will be pursued. The traditional market discipline of fluctuating national currencies no longer exists, but, by toughening up its collateral requirements, the ECB can influence the market signals provided by yield spreads.” (Financial Times, 2005.)*

The drastic change in the ECB’s collateral framework was subsequently documented in the revision of the General Documentation, the document that describes the details of the ECB’s monetary policy framework. The February 2005 edition specified the following among the criteria that needed to be met by assets to be considered as “adequate” collateral:

*“They must meet high credit standards. In the assessment of the credit standard of debt instruments, the ECB takes into account, inter alia, available ratings by market agencies, guarantees provided by financially*

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<sup>6</sup> See also Barrett (2005) and Curtin (2005).

*sound guarantors,[footnote 4] as well as certain institutional criteria which would ensure particularly high protection of the instrument holders.[footnote 5]” (ECB 2005a, p. 40-41.)*

In this version of the General Documentation, no explicit credit rating threshold was specified for any asset and no specific mention was made for the treatment of government debt that would indicate the possibility that collateral eligibility for government debt might be denied merely on the basis of private credit ratings. The revision of the framework could be confirmed by comparing the February 2005 edition of the General Documentation with its subsequent edition, published in September 2006. The September 2006 edition of the General Documentation broadly retained the language in the text quoted above from the February 2005 edition but added the following strict requirement, which applied to all assets, including government bonds:

*“The Eurosystem’s benchmark for establishing its minimum requirement for high credit standards (its “credit quality threshold”) is defined in terms of a “single A” credit assessment.[footnote 23: “Single A” means a minimum long-term rating of “A-” by Fitch or Standard & Poor’s, or “A3” by Moody’s.]” (ECB 2006, p. 41.)*

With its decision to adopt this modification, the ECB delegated the collateral eligibility of the government bonds of euro area member states to three private credit rating agencies.

## 2.6. THE CLIFF EFFECT AND THE EURO CRISIS

In the aftermath of the recession following the global financial crisis, the deterioration of the fiscal position of euro area member states raised questions of long-term sustainability. In a panic, such concerns could lead to fear of default. A default is unnecessary when the fiscal deterioration is not extreme but could still occur as the fear of default may be self-fulfilling. Within a wide range of fiscal fundamentals, the fiscal position of a sovereign may support both equilibria without default and equilibria with default.<sup>7</sup> To prevent unnecessary stress for governments with sustainable fundamentals, the central bank must be willing to accept government debt as collateral even when market participants express fear of default and the sovereign is downgraded. Failing to do so will allow the fear to become self-fulfilling.

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<sup>7</sup> Calvo (1988) demonstrated the presence of self-fulfilling default in government debt markets. De Grauwe (2011) and Corsetti and Dedola (2016) highlighted the issue in the context of the euro area.

The ECB decision to mechanically tie collateral eligibility to credit rating thresholds created the potential for a destabilizing cliff effect thereby precipitating a crisis. If investors projected that the ECB would refuse to accept government debt as collateral even for member states with sound fiscal fundamentals, fears of default would become self-fulfilling. The loss of eligibility could lead to an unnecessary credit event. In light of the potential multiplicity of expectational equilibria in sovereign markets, the credit rating threshold would guide markets to adverse outcomes for “weaker” member states. In the monetary union, investors would scramble to replace lower-rated debt – seen as more likely to fall off the edge of the eligibility cliff – with higher-rated debt, which would remain eligible. The demand for euro-denominated government debt would shift away from states perceived to be “weaker” to states perceived to be “stronger,” inducing an indirect transfer in the form of a risk premium for “weaker” states and a safe haven subsidy for “stronger” states. In a panic, declaring government debt as ineligible collateral merely on the basis of private credit ratings rather than on the basis of fundamentals, would virtually inevitably lead to crisis.

The November 2005 threat to deny collateral eligibility on the basis of private credit ratings was not entirely credible. Given the significance of collateral eligibility of government debt in financial markets, denying collateral eligibility to one of its member states could cause immense economic destruction. Would the ECB deny collateral eligibility to a member state and knowingly cause unnecessary destruction in response to downgrades by private rating agencies, even if objective analysis based on fiscal fundamentals suggested that the member state’s debt was sustainable and could thus be considered “adequate” collateral? Doing so would appear to be inconsistent with the ECB’s mandate to support the economy, without prejudice to its obligation to maintain price stability in the euro area as a whole.

The credibility of the ECB’s decision to delegate collateral eligibility to private rating agencies was tested during the crisis. In October 2008, following a broad wave of downgrades that reduced the pool of private assets that could be projected to remain eligible collateral in the euro area, the ECB reduced the credit rating threshold from “A-” to “BBB-”. This decision suggested that the ECB was fully aware of the adverse consequences of mechanically relying on private credit rating agencies.

Additional complications arose in Spring 2010, when for the first time the government debt of a member state, Greece, was at the edge of the eligibility cliff. On 3 May 2010, the ECB announced that it suspended the minimum credit rating threshold for government debt for Greece. However, the temporary and exceptional nature of the suspension affirmed that collateral eligibility would serve as a disciplining device. The ECB made clear that the suspension of the credit ratings

threshold was conditional on the Greek government's acceptance of conditionality imposed by other euro area governments and the IMF in implementing an adjustment program.<sup>8</sup> Linking collateral eligibility of the government debt to conditionality determined by other euro area member states fully immersed the ECB in the politics of the crisis. It also created a toxic precedent about how governments of "stronger" member states could rely on the ECB to impose conditions on "weaker" states facing liquidity difficulties.

The full force of the potential instability created by the ECB in 2005 was realized following the October 2010 agreement reached in Deauville by the French and German governments. The Deauville agreement implied that if a euro area member state faced liquidity difficulties, capital losses would be forced on investors holding the debt of that state, even if the debt was sustainable. The threat was enabled by the precedent the ECB had created in May 2010 and its 2005 decision to deny collateral eligibility on the basis of credit ratings without regard for fiscal fundamentals and fundamentals-based debt sustainability assessments. The Deauville agreement successfully injected unnecessary default risk in most euro area sovereign markets, thus compromising the safe asset status of government debt. While the French and German governments later pulled back from the automatic imposition of default, the demonstration of how the ECB collateral framework could be used to precipitate default has sustained an elevated credit default risk in financial markets for "weaker" euro area member states relative to other advanced economies with similar or worse fiscal fundamentals.

The ECB's predicament in dealing with euro area government debt over the past few years can be largely attributed to the combination of the cliff effect and the Deauville agreement. Without the cliff effect, the self-fulfilling fears of credit-rating downgrades would have been checked. Prior to Deauville, the ECB could have undertaken monetary policy operations with the assurance that euro area governments would discourage sovereign default in the euro area. Since Deauville, and in combination with the ECB's reliance on credit rating agencies, fear of default has become a feature of most euro area sovereign markets.

## 2.7. REMOVING A SOURCE OF FRAGILITY

The precarious position of the ECB emanating from its discretionary decision to employ its collateral framework as a disciplining device against the governments of euro area member states had been foreseen during the debate that took place in the aftermath of the demise of the SGP in 2005. In his 20 May 2005 speech,

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<sup>8</sup> Bluestein (2016) provides details of the development and consequences of this conditionality.

after stating that the suggestions made at the time were “misguided,” Issing warned about the consequences of moving in that direction:

*“[M]ost importantly, it is clear that the design of the Stability and Growth Pact and its implementation are governmental responsibilities, to be controlled by parliaments. . . .*

*[I]t is not and cannot be the ECB's role to enforce fiscal discipline and to correct shortcomings in the implementation of the Stability and Growth Pact. Attempting to do so would politicise the ECB's operations and ultimately threaten its independence ...”* (Issing, 2005)

While enforcing fiscal discipline may have been a noble objective behind its discretionary decisions, using the implementation of ECB monetary policy as a means to do so has proven destabilizing and warrants reconsideration. The implementation of ECB monetary policy should be designed to fulfill the mandate of the ECB as effectively as possible, and not be determined by considerations that fall outside the ECB's mandate. Using the ECB's discretionary authority to address moral hazard and fiscal discipline concerns regarding the governments of member states, encroaches on the responsibilities of the EC and the governments, and is inconsistent with the ECB mandate.<sup>9</sup> As Issing and Papademos had both suggested in Spring 2005, using the ECB's collateral framework as a disciplining device is contrary to the ECB's mandate.

As a supremely independent institution, the ECB has the discretionary authority to suspend past decisions that do not reflect the best policy for the euro area as a whole, regardless of the original rationale for those decisions. A critical first step should be to suspend the delegation of determining the collateral eligibility of government debt to private credit rating agencies. While the use of credit ratings is understandable as a tool for the evaluation of tens of thousands of private assets, it is inappropriate for euro area governments.

Suspending the reliance on credit ratings for government debt would also be consistent with the ECB's own assessment that the “overreliance” on credit rating agencies (CRAs) should be checked. As the ECB communicated in 2011:

*“The Eurosystem supports the Commission's efforts to reduce the reliance of financial markets and the official sector on CRAs' ratings and to diminish the impact of “cliff effects” on financial institutions and markets. The crisis has shown that the overreliance on ratings, as they are embedded in many regulations and private contracts through ratings downgrades (and their spill-over effects) can destabilise financial markets.”* (ECB, 2011).

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<sup>9</sup> This relates to broader concerns about the ECB, see e.g. Braun (2017).

The ECB's acknowledgment of the destabilizing effect of the "cliff effects" generated by relying on credit ratings ought to make the desirability of suspending the ECB's reliance on credit ratings for government debt obvious.

At the same time, the ECB needs to ensure that it fulfils its responsibilities as best as possible, including the requirement in Article 18 of the Statute relating to its credit operations. The ECB has an obligation to ensure that the government debt it accepts constitutes "adequate" collateral and protects the financial position of ECB. While the ECB should not penalize governments by unnecessarily restricting the use of good collateral, the ECB cannot accept government bonds of a member state as collateral if it knows that the fiscal fundamentals of that member state are not sustainable. This suggests that the criterion for collateral eligibility should be based on fundamentals-based sustainability analysis. Such fundamentals-based analysis should be performed independently by the ECB and explicitly exclude unjustifiable market-based credit risk to stop guiding markets to adverse expectational equilibria.<sup>10</sup> As long as debt is deemed sustainable, on the basis of a fundamentals-based evaluation, it should be considered eligible collateral regardless of private credit ratings. The ECB could protect its financial position in its collateral framework with appropriate use of haircuts. When government bonds are posted as collateral, a graduated schedule of haircuts based on indicators of fiscal fundamentals could be applied to achieve this aim. For example, haircuts could be increasing in a member state's debt-to-GDP ratio. In this manner, the ECB could accommodate differences in the probability of future fiscal challenges in assessing collateral adequacy in credit operations, without relying on credit rating agencies or non-fundamentals-based influences that might contaminate market prices, especially during a crisis.

Modifications along these lines would go a long way towards restoring the safe asset status of euro area government debt and removing one of the key sources of the continuing fragility in the euro area. Eliminating the cliff effect and related undesirable distortions in the ECB's collateral framework for sovereign debt, would also put an end to the indirect fiscal transfers in the cost of financing of government debt from "weaker" member states to "stronger" member states that have been induced by the ECB's earlier discretionary decisions relating to the implementation of monetary policy. Such changes would compress the spreads between government bond yields of "stronger" and "weaker" member states and facilitate the proper functioning of the transmission of monetary policy in the euro area as a whole, in accordance with the ECB's mandate.

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<sup>10</sup> See Orphanides (2017a) for a more detailed discussion and a comparison with inappropriate, non-fundamentals-based sustainability analysis.

By adopting modifications along these lines, the ECB would be refocusing the implementation of its monetary policy to be better aligned with its mandate. The ECB would no longer be cultivating default fears – through the threat of denying collateral eligibility – to induce greater market-based fiscal discipline on euro area governments. The ECB would stop encroaching on the responsibilities of the EC by using its discretionary authority to address concerns about moral hazard. In accordance with the Treaty, the enforcement of the Treaty would be left to the EC and the governments of the member states themselves. Ultimately, the best way the ECB can contribute to the success of the monetary union is by focusing on its mandate.

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### 3. PREFERENCES OF CENTRAL BANKERS: A PREVIEW WITH RESULTS FOR THE CZECH REPUBLIC<sup>1</sup>

*Sylvester Eijffinger and Louis Raes<sup>2</sup>*

#### 3.1. INTRODUCTION

It is well known that monetary policy at central banks is nowadays nearly always set by committees. However, these committees come in various sizes and shapes. Therefore, it should not come as a surprise that we see an increasing attention to the design and composition of central bank committees. Aspects which are studied are the different roles within the monetary policy committee. For example the importance and influence of a chairman has been studied, as well as the potential differences between internal and external members.<sup>3</sup> Furthermore the literature has paid attention to the influence of regional representation, the presence of a political appointment channel or the role of previous career backgrounds.<sup>4</sup> An issue of recent interest is whether gender plays a role.<sup>5</sup>

Our contribution to this literature uses methods developed in political science and the study of judicial bodies.<sup>6</sup> These methods center around the spatial voting model which we estimate using Bayesian techniques. This approach is flexible and provides us with a joint posterior probability distribution over a parameter rich model. The advantage is that we can quickly construct various derived quantities to test different hypotheses, while also keeping track of uncertainty. This is important because (sometimes implicitly) a large part of this literature is interested in the unobservable preferences of monetary policy committee members. These preferences are unobserved and hence need to be inferred or

<sup>1</sup> This paper is a write-up of the presentation given at the SUERF/Baffi Carefin Centre Conference 2017. This paper refers to some updated results from Eijffinger, Mahieu, and Raes (2013).

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<sup>3</sup> On the role of the chairman, see for example Gerlach-Kristen (2003), Chappell, McGregor, and Vermilyea (2004), Riboni and Ruge-Murcia (2008), Harris and Spencer (2009), Bhattacharjee and Holly (2010), El-Shagi and Jung (2015). On the relevance of differential appointment statuses, see Gerlach-Kristen (2009), Besley, Meads, and Surico (2008).

<sup>4</sup> Two papers analyzing the significance of political appointment are Chappell, Havrilesky, and Mc-Gregor (1993), Hix, Høyland, and Vivyan (2010). The effects of regional representation in the FOMC is discussed in Meade and Sheets (2005), Hayo and Neuenkirch (2013), Eichler and Lähler (2014b), Jung and Latsos (2015). The influence (or absence thereof) of career experiences is touched upon in Harris, Levine, and Spencer (2011), Farvaque, Hammadou, and Stanek (2011), Eichler and Lähler (2014a).

<sup>5</sup> See Masciandaro, Profeta, and Romelli (2015).

<sup>6</sup> Eijffinger, Mahieu, and Raes (2017) study the Bank of England. Eijffinger, Mahieu, and Raes (2013) focus on some smaller European central banks. Eijffinger, Mahieu, and Raes (2015) contains ongoing work on the FOMC. Eijffinger, Mahieu, and Raes (2016) is a short discussion of our ongoing work.

estimated. If we estimate these preferences then there is uncertainty surrounding these estimates and our methodology allows to keep track thereof.

Another point we have emphasized before is that most studies are in essence case studies. The voting record of a central bank is studied and conclusions are drawn, for example people with a former career at the central bank vote differently than people with another career background. While this conclusion may be justified, one should be very careful in generalizing this outside the sample studied. For this reason we favor studying different central banks to learn about which conclusions generalize and which conclusions seem bank specific.<sup>7</sup> One important lesson we have drawn from our own research as well as from reading others' papers, is that context is everything.

### 3.2. METHODOLOGY

Our methodology centers around estimating a spatial voting model.<sup>8</sup> Such a model delivers a number of different parameters. For the purpose of this discussion, two parameters are of key importance. At the one hand we estimate the latent preferences of monetary policy committee members which we denote by  $x_n$  with  $n$  indexing a particular monetary policy committee member. At the other hand we have meeting specific parameters  $\alpha_t$ , with  $t$  indexing a particular meeting. The  $\alpha_t$  captures the overall inclination to vote dovish. In a simplified spatial voting model these are combined as follows:  $P(y_{nt} = 1) = \text{logit}^{-1}(x_n - \alpha_t)$ . This equation states that the probability to observe a hawkish vote at meeting  $t$  by member  $n$ , is a function of difference between the meeting parameter  $\alpha_t$  and the ideal point  $x_n$ . If both are equal, there is a 50% chance to observe a hawkish vote (and 50% to observe a dovish vote).

This simple spatial voting model is static and unidimensional. Preferences of monetary policy committee members are determined by a point on a single latent dimension. Also meeting characteristics are reduced to a single parameter. While in principle we are free to increase the number of dimensions, so far we have not done this. The reason is that with one dimension our model fits the data already well. Furthermore, experiments with an additional dimension suggest that this adds little to nothing while requiring additional assumptions to identify the parameters.

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<sup>7</sup> Some papers studying central bank committees other than the MPC of the Bank of England or the FOMC are: Jung and Kiss (2012), Jung (2013), Eijffinger, Mahieu, and Raes (2013), Chappell, McGregor, and Vermilyea (2014), Horvath, Rusnak, Smidkova, and Zapal (2014), Siklos and Neuenkirch (2015), Eichler and Lähler (2017).

<sup>8</sup> This is a very condensed discussion of what we do. A more detailed discussion is provided in Eijffinger, Mahieu, and Raes (2017). This paper also provides a number of key methodological references to the political science and psychometrics literature.

The resulting estimates of the ideal points are thus summaries. They answer the question: *Assume that monetary policy committee members only differ in their dovishness-hawkishness, how should we rank them to explain the observed votes.*

In our experience central bankers are not always fond of this labeling, perhaps because the single dimension suggests that the complex task of monetary policy making can be reduced to a simple point on a line. This is not our intention. Ideal points are a summary with a more sophisticated meaning in our framework. Moreover, labeling monetary policy committee members as doves or hawks is not a unique activity. Many central bank observers do this and often with the use of much simpler (and coarser) approaches.<sup>9</sup>

### 3.3. APPLICATION

We demonstrate our approach with an application to the voting record of the Czech National Bank.<sup>10</sup> We have the voting record from February 1998 until May 2017. Since November 2012 the policy rate is at the lower bound and we do not observe any disagreement anymore. Unanimous meetings are not useful for our study as these do not yield any information regarding differences in latent preferences. This means that our sample runs effectively until November 2012. We recode all votes as choices over two policy rates. In three meetings we had effectively three policy rates proposed. We recode these meetings as two pairwise choices. This leads to 82 meeting-decisions and 21 board members (but we do not always observe all board members). We visualize this data in Figure 1.

This graph shows the number of observed votes per member on the horizontal axis and the number of dovish votes on the vertical axis. Monetary policy committee members with an equal amount of dovish and hawkish votes are expected to be on the dotted line. We see that we have many observations for Tuma and Niedermayer for example. It also becomes clear that we should expect Singer to be dovish and Niedermayer to be hawkish. The results of estimating our spatial voting model on this data confirm this hunch and can be found in Figure 2.

This graph shows a historical ranking. We see the estimates of all committee members on a dove-hawk dimension. Our approach allows us to rank these committee members even though some of them never sat together in a meeting. This can be done because of bridging observations. If we know that A is more

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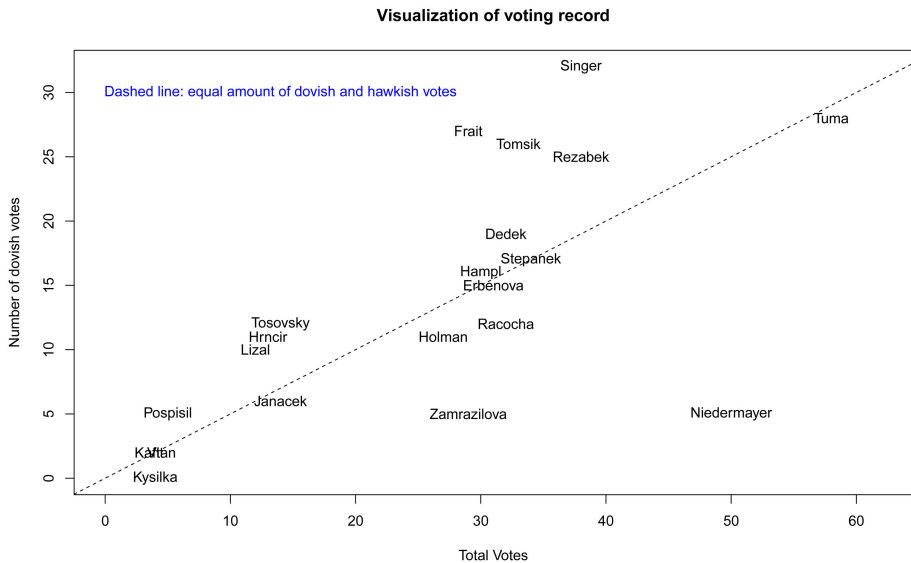
<sup>9</sup> See Hix, Høyland, and Vivyan (2010) for a comparison with the so-called batting scores to classify central bankers. Also academia has adopted the labels doves and hawks. See for example Jung (2013) or Favaretto and Masciandaro (2016).

<sup>10</sup> The spatial voting model we used here is slightly more involved but this has no implications for the interpretation of the results. These results are an updated version of the results for the Czech National Bank discussed in Eijffinger, Mahieu, and Raes (2013).

dovish than B and B is more dovish than C, we can infer that A is more dovish than C. Having many bridging observations allows for a finer ranking.

Having these estimates in hand we can look at various features and construct derived quantities of interest. Consider for example the position of the governor. In our data we have eight different board compositions. For each of these compositions we calculated the probability that the sitting governor occupied rank 1 (most to dovish), rank 2 (second most dovish), up to rank 7 (most hawkish). The results of this calculation is given in Figure 3. We notice that the governor in all these different compositions tended to occupy either the middle ground (the natural position of a governor) or he was dovish-leaning. This is not something we find at every central bank. For example, if we do a similar exercise for Hungary, we would find that Jarai would be classified as a hawk.<sup>11</sup> The explanation for this finding is related to the politization of the Hungarian monetary policy committee at that time.<sup>12</sup> As further discussion of this is beyond the scope of this short note, but it shows that one should be careful in generalizing certain findings.

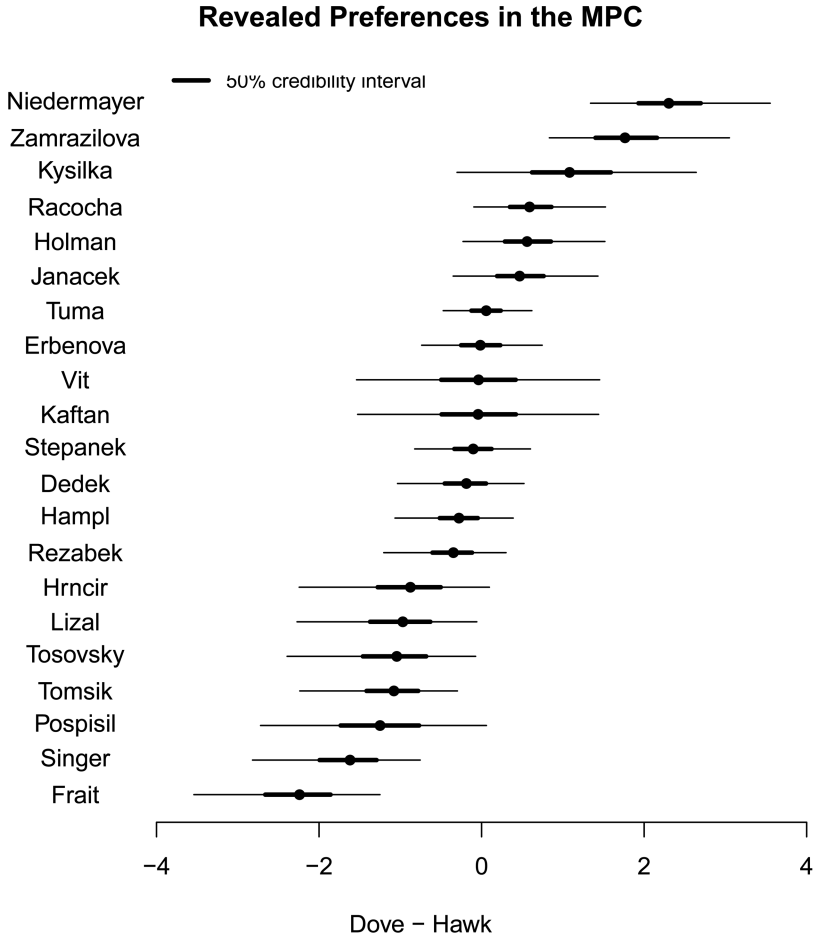
**Figure 1:** This Figure visualizes the data we use to estimate the ideal points. This is after having cleaned and recoded as described in the text.



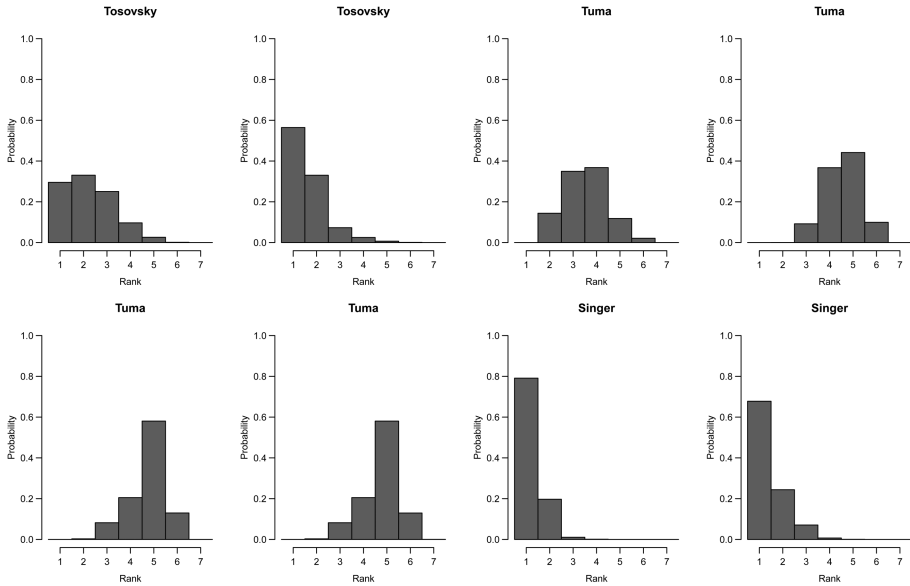
<sup>11</sup> See Eijffinger, Mahieu, and Raes (2013).

<sup>12</sup> An insightful quote to highlight this was given by Jarai himself. He referred to his tenure at the Monetary Council as *one year of work and five years of fighting*.

Figure 2: A *historical* ranking of the Czech monetary policy committee members on a common dove-hawk scale. The dots indicate the estimated ideal points. The lines denote the 50% and 95% credibility intervals (Bayesian confidence intervals).



**Figure 3:** This Figure show for each different board composition the probability that the governor occupies a certain rank with ranks going from 1 (most dovish) to 7 (most hawkish). See also Eijffinger, Mahieu, and Raes (2013) for a further discussion.



### 3.4. CONCLUSION

In this short note we aimed to show how spatial voting models are a useful tool to study voting records at central banks and hence a neat addition to the toolkit of researchers in this area. We have demonstrated this with an application to the voting record of the Czech National Bank.

We have also argued that researchers interested in the design of central bank committees or monetary policy in general should use the available data for central banks other than the major central banks to see whether conclusions hold more generally.

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#### 4. GENDER DIVERSITY AND BEHAVIORAL MONETARY POLICYMAKING: THEORY, INSTITUTIONS AND EMPIRICS

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*This short note presents the results of a forthcoming paper that analyses the gender representation in monetary policy (MP) committees. The paper will offer three contributions. First of all it will be claimed that the gender diversity is likely to influence the MP decisions the more it is true that the gender diversity influence the risk aversion via two possible channels: conservativeness and/or loss aversion. In order to test such assumption a metric is needed. Then and secondly we propose the first index to evaluate the gender representation in monetary policymaking – i.e. the GMP Index – for a sample of 112 countries as of 2015. Finally we investigate the possible empirical relationships between gender diversity and MP performances.*



Women are increasingly represented in central banks. As of January 2015, 16 central banks were headed by women, either on an interim or full-time basis, the most known being Janet Yellen in the US and Elvira Nabiulina in Russia. In general women's representation in monetary policy committees seems to have increased in the last years. Then a natural question arises: Are women in central banks affecting monetary policy?

Our research assumption is that if the gender diversity – i.e. the female preferences – are associated with risk aversion such a feature can matter in shaping the MP decisions.

So far the role of preferences in shaping the monetary policy stance has been explored by focusing on the degree of activism in designing and implementing monetary policy actions. High inflation performances are usually correlated with active (Keynesian) monetary policies (Eijffinger and Masciandaro, 2014). Policy-makers tend to use monetary tools with an anti-cyclical perspective, using the inflation tax to smooth different kinds of macroeconomic shocks – i.e. real (Barro and Gordon, 1983) and/or fiscal (Sargent and Wallace, 1981) unbalances – thus trying to exploit the trade-off between real gains and nominal (inflationary) costs.

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In this literature, a specific jargon has been coined: a “dove” is a policymaker that likes to implement active monetary policies, while a “hawk” one dislikes these policies (Chappell et al., 1993; Jung, 2013; Jung and Kiss, 2012; Jung and Latsos, 2014; Eijffinger et al., 2013a, 2013b and 2013c; Neuenkirch and Neumeier, 2013; Wilson, 2014; Eijffinger et al., 2015). Throughout time, the dovish/hawkish attitude may become a more important focus of the analysis of monetary policy decisions.

In exploring the drivers of the monetary policy preferences, the attention zoomed also in on the possible role of gender diversification. Chappell and McGregor (2000) were among the first to draw the attention to gender. Using voting records and board transcripts, their study documents the voting behavior of individual FOMC members over the period 1966-1996, providing a ranking by preference for ease – dovishness – of 84 individuals who served on the FOMC. During this period, seven women have served on the FED board and six of them are ranked among the thirteen most dovish members. In other words, this study shows that female members of the FOMC could more often be qualified as doves rather than hawks.

It is interesting to note that the dovish attitude in the actions and/or in the representation of women behavior has been already analyzed in political sciences. A prominent line of research has shown that voters tend to view female candidates as associated with a dovish behavior, i.e. being more competent in social welfare policies, while men are perceived to be more hawkish, focusing more on other policy areas, such as national security, defense and crime (among others: Lawless, 2004; Dolan, 2010; Thomsen, 2011). Therefore, dovishness can be considered a gender trait. In general, if women care more about social problems, in the field of monetary policy this may imply that women are more likely to use monetary tools to fix cyclical macroeconomic problems.

Recently, the interest on the link between gender and dovishness has been revived. Farvaque et al. (2010) study the impact of the composition of monetary policy committees on the inflation performances of nine central banks from major OECD countries and 175 central bankers, over the period 1999-2008. In their sample, lower inflation levels are associated with a higher share of female members; therefore, women seem to be more hawkish, and the gender issue is more important in inflation targeting countries.

Given the controversial results obtained so far, we decided to test whether gender diversity in central bank boards affects the conduct of monetary policy and hence macroeconomic outcomes (Masciandaro et al., 2016). On top of that we explore a novel channel that can explain the relevance of gender, i.e. the loss aversion. To that end, we started with a theoretical framework, applying in a special case the model proposed in Favaretto and Masciandaro 2016.

The overall rationale is simple: the starting point is a standard New Keynesian economy with nominal rigidities and rational expectations where an independent central bank sets monetary policy, and the interest rate is the monetary policy tool.

Then it is possible to introduce sequentially the assumptions that each central banker is a high-ranking bureaucrat – i.e. a career concerned agent – with his/her conservativeness, that a Monetary Policy Committee (MPC) formulates monetary policy decisions voting with a simple majority rule, and finally that loss aversion characterizes the behavior of the central bankers – i.e. for every monetary policy choice, losses loom larger than gains, and both are evaluated with respect to the *status quo*.

The modified model shows that, given three types of central bankers (doves, pigeons – i.e. the central bankers that likes the status quo – and hawks) the introduction of loss aversion in individual behavior influences the monetary policy stance under three different but convergent mechanics.

First of all a *Moderation Effect* can emerge: the more relevant is the loss aversion among the central bankers the more likely is the case that the MP inertia will occur. At the same time also a *Hysteresis Effect* can become relevant: when loss aversion is relevant, also the central bankers that dislike the status quo – i.e. doves and hawks – soften their stances. Thirdly a *Smoothing Effect* tends to stabilize the number of pigeons: in order to change the status quo a relevant shock in the inflation preferences is needed. The three effects consistently trigger higher interest rate inertia, which is independent from both the existence of frictions and the absence or presence of certain features of central bank governance.

Finally the crucial assumption is highlighted: the more is true that gender diversity is associated with well identified risk preferences – conservativeness and/or loss aversion – the more will be true that such MP committee feature can be relevant in shaping the monetary policy decision. Therefore the research question becomes genuinely empirical.

In order to perform empirical analyses a metric is needed. Monetary policy (MP) boards all over the world share a special common feature: they are very restricted and elitist bodies. In order to investigate issues related to MP committees' membership, the best approach would be to count on micro data. Indeed, not only the size or the composition of the board can foster different kinds of composition, but also personal characteristics and background can shape the board identity.

Following this assumption and looking for the drivers of women presence in MP boards worldwide, it would be useful to have a complete database including both micro and macro data. In particular, a detailed description of each single member in terms of her personal features and background – marital status, family

situation, educational background, work experience – could provide a great contribution in specifying the reasons of her membership.

Unfortunately working on micro data is difficult. There are very few central banks websites that integrate the board composition with exhaustive bibliographies of their board members and no specialized books that comprehend the amount of information we need. Hence, given the data availability, we decided to rely on macro data, performing a systematic analysis of 112 heterogeneous countries.

To that end, we construct a new index that captures the gender diversity of monetary policy boards. We dub this index the GMP Index, which measures the share of women in MP committees. To the best of our knowledge, this represents the first systematic attempt to quantify the number of women having official power in monetary policy boards for such a large set of countries.

The rationale of the GMP Index is straightforward: the GMP ratio simply relies on the quotient between the number of women on the board and the total number of its members. Indeed, we decide to keep the ratio in its raw shape, considering all kind of possible corrections (for GDP levels, for special roles inside the board etc.) misleading to our scope. The GMP ratio has been constructed using several sources including the Central Bank Directory 2015, central banks' websites and other official documents. The Central Bank Directory provides us with core information about central banks' board members and women involvement in monetary policy. Information directly from the websites aim at enriching the dataset.

The main descriptive results can be summarized as follows. The average share of women in MP committees in our sample of 112 countries is 16%, however the variability among countries is quite high, with a standard deviation of 0.17. Regarding the characterization of our indicator across countries and regions, at least two elements can be highlighted: 1) the size of monetary policy boards all over the world varies within a restricted range; 2) our sample includes two monetary unions that simultaneously share the same central bank – the ECB for 19 countries in Europe and the BCEAO for 8 countries in West Africa – and limit the variability of the GMP ratio.

Regarding the geographical distribution of our index two peculiarities can be highlighted: positive outliers are countries in the Caribbean, North America and Africa, while negative outliers are countries in South and Central America. However, it seems unlikely to extrapolate strong geographical regularities from the GMP distribution.

It is also possible to split the sample respectively by country income and official religion. Low income economies involve more women in their monetary policy

activity than higher income ones. This evidence appears quite counterintuitive since it is generally considered that, in advanced economies, women have relative more opportunities.. It is worth noting another interesting pattern: women's share in monetary policy boards is relatively high in countries in which the official religion is Protestant or Lutheran but also in those Orthodox Christians. Instead, it is definitely under the sample average in Roman Catholic countries.

Finally it is possible to implement a temporal comparison between two average values of the GMP Index, respectively in 2015 and 2010. In the last 5 years, the percentage of women in monetary policy boards has risen by less than one percent and in a very heterogeneous way, with some countries even experiencing reductions in their quotas. This result seems to be counterintuitive if associated with the recent appearance of a consistent number of women as presidents of relevant central banks, such as the FED or the Central Bank of Russia.

All the descriptive results deserve a closer investigation that we perform in the econometric section.

In such a section we augment several classical models of monetary economics by introducing the newly created index of gender diversity (GMT Index). So far we find a negative and highly significant link between the gender composition of monetary policy boards and average inflation rates, after controlling for the usual determinants of inflation dynamics such as level of central bank independence (CBI), output gap, past inflation, trade openness, and a dummy for inflation targeting countries and for OECD members. Our goal is to verify if the degree of gender diversity in boards matters, even after taking into account the classical control variables used to explain inflation rates dynamics.

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## 5. LIQUIDITY, DEFAULT AND MACROPRUDENTIAL POLICY<sup>1</sup>

*Dimitrios P. Tsomocos*<sup>2</sup>

### 5.1. INTRODUCTION

Liquidity and default have frequently been regarded as two separable concepts. Our view, instead, is that for the most interesting and important aspects of financial stability issues, they are inherently intertwined. My work with Charles Goodhart and our co-authors has focused on the importance of default in macroeconomic analysis, which has not been until recently fully appreciated as much as other frictions, such as sticky prices or search frictions (see for example, Bhattacharya, Goodhart, Tsomocos and Vardoulakis, 2015, Goodhart, Sunirand and Tsomocos, 2004 and 2006, Goodhart, Kashyap, Tsomocos and Vardoulakis (2012 and 2013, Goodhart, Peiris and Tsomocos, 2013 and 2016, Goodhart, Peiris, Tsomocos and Vardoulakis, 2010 and Goodhart, Tsomocos and Vardoulakis, 2010).

Under the presence of multiple externalities, especially default, and the evolving nature of markets, in particular for short-term funding, the forthcoming regulatory architecture should recognise that there are markets that are “too important to fail” and not only banks that are “too big to fail”. Hence, regulation, and policy more generally, should also be focussed on “systemic markets” as well as “systemic institutions”.

This short note provides a summary of my work with Charles Goodhart and our co-authors on bringing financial stability and banking institutions into macroeconomic analysis to answer a variety of questions. Section 2 describes some basic modelling elements that make the interaction of default and liquidity interesting, while maintaining the General Equilibrium spirit of the analysis. In section 3, an attempt to incorporate more elaborate banking sectors in General Equilibrium is presented, which have a number of important real economic functions generating multiple externalities. The ability of macroprudential regulation to tackle these market failures is also discussed. Finally, section 5 concludes.

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<sup>1</sup> This note is based on Peiris, Tsomocos and Vardoulakis (2016).

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## 5.2. A MODEL TO ANALYSE FINANCIAL FRAGILITY

The key components when building a model to analyse financial stability should include:

1. Inter-temporal decisions (as banks facilitate consumption smoothing demands of customers);
2. Uncertainty in the future (as banks face risk of maturity mismatches and uncertainty in loan portfolio value over time);
3. Liquid wealth or money (as the scarcity of liquidity generates costs in financial intermediation);
4. Endogenous default (as the actions of households and banks jointly determine aggregate financial stability conditions and, consequently, financial distress);
5. Incomplete risk sharing (as financial stability conditions affect welfare).

The suite of models that we have been working on over the last 20 years have attempted to combine these elements within a single coherent framework and used it to address several issues: procyclicality of the Basel Accord (Catarineu-Rabell, Jackson and Tsomocos, 2005), collateral, money and default (Goodhart, Tsomocos and Vardoulakis, 2010, Peiris and Vardoulakis, 2015, and Lin, Tsomocos and Vardoulakis, 2016), Minsky's financial instability hypothesis, risk-taking and excessive leverage (Bhattacharya, Goodhart, Tsomocos and Vardoulakis, 2015), international capital flows (Goodhart, Peiris and Tsomocos, 2013b, and Peiris and Tsomocos, 2015), dividend restrictions and financial regulation (Goodhart et. al., 2010a, and Goodhart et. al., 2013a), precautionary savings and default (Peiris and Vardoulakis, 2013), monetary policy and debt renegotiation (Goodhart, Peiris and Tsomocos, 2016).

### 5.2.1. Basic economic environment

There are multiple household-types that differ, at least, in their non-financial income stream and desire to smooth consumption. Households conduct financial transactions through a banking system composed of multiple bank-types that differ, at least, in the balance sheet characteristics they accrue. Surplus households make deposits at banks that, in turn, extend funds to deficit households in the form of commercial or consumer loans and mortgages. There also exists an interbank market where banks with excess liquidity extend credit to deficit banks. When loans and deposits come due, fundamental uncertainty in the economy generates incentives for debtors to default. Households may suffer income or wealth losses which increase the marginal cost of repayment. This then is contrasted with the marginal costs of default, modelled as non-pecuniary (e.g.,

reputation) costs incurred by defaulting on the volume of debt. Individual optimality results in an endogenous default rate.

Alternatively, if debt is secured by collateral such as housing, fluctuations in the price level or the relative value of the collateralised good, may result in default. Banks face similar incentives for the loans obtained from the interbank market. As a consequence, default from one sector is transmitted through the banking sector to the entire economy.

All transactions require fiat money the creation of which is a monopoly of the Central Bank. Liquid fiat money is obtained by exchanging illiquid debt with the central bank, at a cost. Expanding the amount of money in the economy reduces the cost of liquidity, or equivalently, increases the liquidity of private assets and household endowments, and increases the efficiency of all transactions. Importantly, infinite liquidity may not be optimal as the limiting economy itself is inefficient due to market incompleteness and agent heterogeneity.

The model is summarised by three key equations:

1. The Quantity Theory of Money (which summarises the intra-temporal relationship between liquidity, the nominal price level and real trade);
2. The Term Structure of Interest Rates (which summarises the inter-temporal transmission of shocks);
3. The On the Verge condition (which summarises the marginal propensities of households and banks to default).

The full details of the model are described in Tsomocos (2003) and Goodhart, Sunirand and Tsomocos (2006).

### 5.2.2. Definition of financial stability

The model offers a model-based definition of financial fragility that is characterised by substantial default of a ‘number’ of households and banks (i.e., a liquidity ‘crisis’), without necessarily becoming bankrupt, and a significant decline in the aggregate profitability of the banking sector (i.e., a banking ‘crisis’). A natural question is why either one of the conditions is not sufficient by itself to constitute a financially fragile regime. Increased default without reduced profitability might be an indicator of increased volatility and risk taking without necessarily leading to financial instability. For example, both the mean and variance of return might have risen. On the other hand, lower bank profitability without increased default might be an indicator of a recession in the real economy and not of financial vulnerability. It is the combination of both conditions that destabilises the financial system and may produce financial crises

### 5.2.3. Results

In this model, both regulatory and monetary policies are non-neutral and arise from the presence of incomplete financial markets and liquidity constraints (since all trade is mediated with liquid assets i.e., money). Monetary and regulatory policies influence the distribution of income and wealth amongst heterogeneous agents and hence have real effects. Some other main results are:

- the central bank controls the overall liquidity of the economy and such liquidity, as well as endogenous default risks, determines interest rates;
- nominal changes (i.e., changes in monetary aggregates) affect both prices and quantities; and
- the nominal interest rate is equal to the real interest rate plus the expected rate of inflation (Fisher effect).

From an analysis of a set of comparative statics exercises, using the model, a number of implications arise that capture various stylised facts and, furthermore, the model can be used for policy implementation in a context specific manner.

## 5.3. MAKING MACROPRUDENTIAL REGULATION OPERATIONAL<sup>3</sup>

In Goodhart et al. (2012) and Kashyap et al. (2014b and 2017) we expand on the economic function that financial intermediaries play in the economy, study in detail the externalities associated with their behaviour and suggest regulation to tackle the inefficiencies. We focus on two principles of financial regulation.

- Our first principle is that it is imperative to start with a general model where the financial system plays all three of these roles.  
and
- Our second principle is that intermediaries should operate in an environment where the savers who use them are forward looking, and the prices the intermediaries face adjust (endogenously) to the regulatory environment.

We are unaware of any existing models that satisfy these two principles. So, in Kashyap et al. (2014b and 2017), we have constructed one by modifying the classic Diamond and Dybvig's (1983) framework. In their original model, banks only provide liquidity insurance to savers (by allowing depositors the option of withdrawing early), so there is no other risk-sharing or additional lending that takes place because of banks. Our modifications are designed so that banks also provide these services. The full details of the model are provided in Kashyap et al. (2014b and 2017).

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<sup>3</sup> This section borrows material from Kashyap et al. (2014a).

### 5.3.1. Some general findings of the model

First, as a benchmark, we compute the portfolio allocations that a central planner would make. We find that approximating the planner's allocations with just one regulation is impossible. In this model, it takes at least two tools to overcome the two distortions. Second, the way that the various regulations change behaviour is very different, and combining some of them leads to very little improvement. Third, the interactions among the regulations are sufficiently subtle that it would be hard to guess which combinations prove to be optimal in this model.

We do not want to claim that our model is sufficiently general that the findings necessarily apply in all other models. But, attempting to assess different regulations (and to calibrate how they should be set) would be very difficult to do without consulting a range of models. Intuition helps, but at some point it runs out.

Finally, coming up with regulations that simultaneously eliminate runs and shrink total lending (and risk-taking) is hard. This happens because the usual interventions that make runs less likely either create opportunities for banks to raise more funds or take more risk, or so severely restrict the savers, banks or borrowers that one of them is made much worse-off.

We hope that these ideas will lead others to move away from small perturbations of existing DSGE models and instead consider much more fundamental changes.

## 5.4. CONCLUDING REMARKS

In reality, the economic system is both complex and heterogeneous. In order to model it in a way that is mathematically tractable, rigorous and yet simple enough to be illuminating, economists have often tended to assume homogeneity amongst agents in the sectors involved. Unfortunately that prevents analysis of certain key features of financial fragility, especially those relating to interbank interactions.

Some minimum structural characteristics should be present in any model attempting to capture fundamental aspects of financial instability and correcting for multiple externalities. First, it should be multiperiod, with aggregate uncertainty and agent heterogeneity. Different actions and policy recommendations are necessary for crisis resolution depending on the structure of economic uncertainty and the impact on various economic sectors. Second, default and missing financial markets should be part of the model so as not every eventuality can be hedged; thus making regulation and policy relevant. Third, money and liquidity constraints should be explicit, since financial crises evolve from the nominal sector and subsequently spread to the real economy. Fourth, since the perfor-

mance of banks is critical for the study of financial fragility and contagion, a banking sector well integrated in the model is indispensable to any modelling attempt. Finally, the regulatory framework should be clearly defined for policy and sensitivity analysis of various regulatory regimes and the associated distributional and welfare consequences.

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## 6. THE USAGE OF MACROPRUDENTIAL POLICIES: A CROSS-COUNTRY PERSPECTIVE

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### 6.1. INTRODUCTION

Macroprudential instruments are nowadays an important part of the policy-making toolkit to promote financial stability.<sup>2</sup> The objective of macroprudential policies is often: increase the resilience of the financial system to shocks (e.g., by building capital buffers); to contain the build-up of vulnerabilities over time (e.g., by reducing procyclical feedback between asset prices and credit); and to control structural vulnerabilities arising through interlinkages and the critical role of individual intermediaries in key markets that can render individual institutions “too big to fail.”<sup>3</sup>

The fast expanding empirical literature on the analysis of macroprudential policies can be divided into two groups. A first group seeks to uncover – by taking advantage of detailed, confidential datasets – whether specific macroprudential instruments are effective in reducing procyclicality and the build-up of systemic risk within economies. Some examples are: Jiménez, Ongena, Peydro, and Saurina (2012), using Spanish micro-data, document that dynamic provisioning can be useful in taming credit supply cycles, even though it did not suffice to stop the boom. Using sectoral data, Igan and Kang (2011) find LTV and DTI limits moderate mortgage credit growth in Korea. Using bank-level information in the UK before the crisis, Aiyar, Calomiris, and Wieladek (2014) show that bank-specific higher capital requirements dampened lending by banks in the UK, with strong aggregate effects.

A second group pursues a cross-country approach, and they are the focus of this chapter. More specifically, this chapter summarizes the usage of macroprudential tools following Cerutti, Claessens, and Laeven (2017). This paper and associated dataset documents the use of macroprudential policies for the largest number

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<sup>1</sup> The views expressed here are those of the author and do not necessarily represent those of the IMF and IMF policy. E-Mail: [ecerrutti@imf.org](mailto:ecerrutti@imf.org); This paper summarizes the findings of Cerutti, Claessens, and Laeven (2017) and Cerutti, Correa, Fiorentino, and Segalla (2017). The links to the two datasets produced on those papers are available in <http://www.eugeniocerutti.com/Datasets>.

<sup>2</sup> Many of these macroprudential tools are based on existing microprudential instruments, and a full distinction between these two types of policies is blurry, and their differences are mostly based on the particular perspective used (Crockett, 2000; Borio, 2003; Claessens, 2015). Microprudential policy seeks to ensure the soundness of individual financial institutions, while macroprudential policy aims to contain systemic risks in the financial system as a whole. Other instruments in the macroprudential toolkit are taxes, levies, and capital flow measurements.

<sup>3</sup> See Claessens (2015) for more details as well as an extensive literature review.

of countries available today, 119, over an extended period, 2000-13, and covering 12 instruments. We summarize their main usage calculations on which countries have used what policies most frequently, as well as their findings with respect to the effectiveness of different macroprudential policies in terms of reducing the growth of credit, covering both household and corporate sector credit. Then, this chapter turns its attention to the intensity in the use of a few of these macroprudential instruments. The implicit assumption in Cerutti, Claessens, and Laeven (2017) is that a country would actively use an instrument once it is written into a law or into regulatory rules. This is not necessarily associated with frequent changes in the intensity of the usage of many instruments as the dataset and descriptive statistics compiled by Cerutti, Correa, Fiorentino, and Segalla (2017) have shown. This second dataset offers a different perspective on the usage of macroprudential policies, at quarterly frequency (2000Q1 to 2014Q4), but at the cost of reducing the country coverage to 64 countries and 5 instruments.

In general, both reviewed papers and associated datasets highlight high heterogeneity in the usage of macroprudential instruments across countries and over-time. Although the evidence with respect to the effectiveness of macroprudential policies is limited, in part due to the fact that many macroprudential instruments were introduced after the Global Financial Crisis, both datasets and the increasing literature seem to indicate that they can play a role in achieving financial stability.

The rest of the chapter is organized as follows. Section 2 summarizes the results of Cerutti, Claessens, and Laeven (2017). Section 3 performs a similar review of Cerutti, Correa, Fiorentino, and Segalla (2017). Section 4 concludes.

## 6.2. THE ACTUAL USE OF MACROPRUDENTIAL POLICIES

The macroprudential data compiled in Cerutti, Claessens, and Laeven (2017) originates in a comprehensive IMF survey based on responses received directly from country authorities. These answers were also cross-checked and complemented with other surveys (e.g., Kuttner and Shim, 2013 and Crowe et al. 2011) and material published to ensure a high-quality dataset. The 12 specific macroprudential tools covered in the dataset are: General Countercyclical Capital Buffer/Requirement (CTC); Leverage Ratio for banks (LEV); Time-Varying/Dynamic Loan-Loss Provisioning (DP); Loan-to-Value Ratio (LTV); Debt-to-Income Ratio (DTI); Limits on Domestic Currency Loans (CG); Limits on Foreign Currency Loans (FC); Reserve Requirement Ratios (RR); and Levy/Tax on Financial Institutions (TAX); Capital Surcharges on SIFIs (SIFI); Limits on Interbank Exposures (INTER); and Concentration Limits (CONC).



Focusing only on capturing usage, macroprudential instruments are each coded for the period actually in place, i.e., as simple binary measures whether or not in place. An overall macroprudential index (MPI) is the simple sum of the scores on all 12 policies. While tools can be grouped in many ways, one commonly used two-way classification is borrowers – (LTV and DTI ratios), and financial institutions – oriented tools (DP, CTC, LEV, SIFI, INTER, CONC, FC, RR, CG, and TAX).

Over the period 2000-2013, countries generally increased their usage of macroprudential measures. As depicted in Figure 1, starting with an average MPI of just above 1 in 2000 and ending at almost 2½ in 2013. In terms of tools, most countries have used concentration limits (CONC): in about 75 percent of the country-year combinations and evenly across country groups. This is followed by INTER (29 percent), RR\_REV (21 percent), LTV\_CAP (21 percent), DTI (15 percent), LEV (15 percent), TAX (14 percent), FC (14 percent), CG (12 percent), DP (9 percent), CTC (2 percent), and SIFI (1 percent).<sup>4</sup>

There are large differences across countries. Usage is the most frequent among emerging markets (see Figure 1), consistent with their higher exposure to external shocks, including from volatile capital flows. Developing countries come in second and advanced countries last, despite their recent increase in usage. CONC, INTER, and LEV, however, are consistently used by all countries alike. LTVs are used relatively more by advanced countries, maybe due to their concerns about housing sector related vulnerabilities, typically larger as mortgage markets are more developed. RR and FC are used more by emerging countries, maybe due to their concerns with large and volatile capital flows and related systemic risks; and DP and CG are used more by developing countries, which also rely relatively more on RR and FC.

### 6.2.1. Effects of macroprudential policies

To analyze the effects of the various instruments, Cerutti, Claessens and Laeven (2017) estimates a basic panel regression model that relates the growth in countries' credit and house prices to the aggregate index, MPI, or to groups or individual instruments. It also includes the lagged dependent variable and controls for factors such as the country's real GDP growth year, the presence of a banking crisis, the central bank policy rate, as well as use a country fixed effect.

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<sup>4</sup> The same top 4 instruments are selected if the definition of usage is changed to being used in at least one year during the period 2000-03. CONC was used in 64 percent of the 119 countries in their sample, RR in 37 percent of the countries, and LTV and INTER in 29 percent of the countries.

The MPI and all other instruments are lagged by one year to capture delayed impacts.

Their main results, presented in Table 1, show that overall macroprudential usage has significant mitigating effects on credit developments: a one standard deviation change in MPI, a change of 1.5, large relative to the mean of 1.8, reduces credit growth by some 11 percentage points. This effect is the strongest for developing and emerging markets, where a one standard deviation change in MPI reduces credit growth by 9 and 8 percentage points, respectively, equivalent to  $2/3^{\text{rd}}$  and  $1/2$  its standard deviations. For advanced economies, effects are less: a one standard deviation change in MPI reduces credit growth by some 2 percentage points, equivalent to about  $1/4^{\text{th}}$  its standard deviation. Although still significant in open economies, policies are more effective for relatively closed economies, with a coefficient twice as large.

In terms of control variables, the degree of persistence in credit developments at the country level is larger in advanced countries. Economic growth has a positive coefficient, as expected, and a relatively high elasticity. There are some dampening effects of higher interest rates but these are relatively small, also compared to that of MPI: a one percentage point interest rate increase reduces credit by 1 percentage point across the entire sample. This suggests that macroprudential policies are on average more powerful compared to monetary policy. A country experiencing a banking crisis means a reduction in credit of some 14 percentage points.

### 6.2.2. Type of macroprudential policies

Borrower-based measures are generally negatively related to credit growth, with effects the highest for credit to households and in emerging markets. Financial institutions-based policies are also associated with lower credit growth, especially in emerging and closed economies. These results are consistent with policies being more effective in emerging markets and relatively closed capital account countries than in advanced and relatively open countries. While various borrower-based measures have negative signs in the specifications using house prices as dependent variable, they are not significant, consistent with other findings that house prices are difficult to moderate using macroprudential policies. Rather, since, as analyses have shown (e.g. Cerutti, Dell’Ariccia, and Dagher, 2017), borrower-based macroprudential policies, such as LTVs, can play a useful role in dampening household indebtedness, especially in advanced countries.

Of the individual policies, caps on LTV are found to be in developing countries strongly associated with lower overall credit growth, and with less household credit in all countries. DTI limits help as well, especially for household credit in

both advanced and emerging markets, and corporate credit in emerging markets. Overall, and confirming earlier results, direct limits appear very effective, especially for household credit. Foreign currency limits (FC) are negatively related to credit growth, especially in emerging markets and developing countries, to corporate credit growth, again especially in emerging markets, and to household credit in advanced countries. And for emerging markets (RR are not used in advanced economies), RR affect strongly any type of credit, but especially corporate credit growth.

In terms of other policies, dynamic provisioning, almost exclusively used in emerging markets, has a negative relation with overall credit growth. LV and CTC have negative effects in developing countries. INTER and CONC are negatively related to credit growth in all markets, with effects for interconnection driven by emerging markets and developing countries. Tax measures dampen growth in overall credit in developing countries and house prices in emerging markets. Otherwise, most other policies used are not significantly negatively related to credit and house prices' growth. They do also find that the greater use of policies is associated with more reliance on cross-border claims for open economies, with a one standard deviation increase in MPI increasing the cross-border ratio by 6 percentage points, about 1/3<sup>rd</sup> its standard deviation.

Taken together, results suggest borrower-based measures have an impact for most countries, while foreign currency related measures are more effective for emerging markets. This suggests some scope for targeted policies such as LTV and DTI ratios in advanced economies and foreign currency related policies in emerging markets. These are important findings given the, at times, adverse effects on overall financial and economic stability of real estate developments in advanced countries and of international capital flows for emerging markets. Their findings suggesting evasion, however, do point to the need to consider countries' circumstances, and to possibly adopt macroprudential and capital flow management policies simultaneously and in an integrated manner (see also Ostry et al. 2012).

### 6.3. CHANGE IN INTENSITY OF THE USAGE OF MACROPRUDENTIAL POLICIES OVERTIME

Following Cerutti, Correa, Fiorentino, and Segalla (2017)'s paper and associated dataset, this section documents the changes in the intensity (tightening or loosening) in the usage of several key widely used macroprudential tools. At a cost of a reduced coverage of countries (64 countries instead of the 119 countries covered in the previous section) and instruments (5 macroprudential indices instead of the previously covered 12 tools), this quarterly dataset, covering the

period 2000Q1 to 2014Q4, shows that there is also a high heterogeneity in the frequency of tightening and loosening across macroprudential instruments.<sup>5</sup>

Five types of macroprudential instruments are covered: INTER, CONC, LTV, and RR – which were the four most used instruments in the previous section – as well as capital requirements (general and specific capital requirements), one of the main pillars of modern bank regulatory frameworks. For two of the instruments, there are also subcomponents. In the case of the sector specific capital buffers (SSCB), there are available indices for buffers that apply separately to real estate loans, consumer loans, and other loans. Similarly, for RR, there are indices for policy changes that apply to accounts denominated in foreign currency and domestic currency. Adding these sub-components, the total number of prudential indices increases to nine.

This quarterly dataset uncovers several interesting patterns when analyzing the changes in usage intensity. First, even though CONC and INTER are two widely used prudential instruments, their intensities (in terms of loosening or tightening) are not often adjusted. This is shown in Table 2, which reports information on the number of countries with policy changes (tightening and) for each instrument. In the case CONC and INTER about 22 and 14 countries implemented changes in those instruments respectively, with almost all tightening the requirements. This tightening bias is also clearly present in the case of general capital requirements, where almost all countries tightened capital requirements following the implementation of the different Basel accords. Specific capital requirements display some more even tightening and loosening episodes, but not as much as LTV and RR (on foreign and local currency), which display the largest numbers of tightening and loosening episodes (see also Figure 2). In general, the evidence suggests that instruments linked to capital buffers, CONC, and INTER have been used to achieve structural objectives, such as creating capital buffers, and lowering risks either with a micro or macroprudential perspective.

### 6.3.1. Cyclical or counter-cyclical usage?

Conditional on usage, this observation is supported by the low correlation between the changes in instrument intensity and real credit growth as shown in Figure 3. Moreover, the correlations for LTV ratio limits, and foreign and local currency reserve requirements, with credit growth signals a counter-cyclical usage by authorities in most cases.<sup>6</sup>

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<sup>5</sup> This dataset was produced as part of the 2015 International Banking Research Network (IBRN) initiative, which examines domestic effects and international spillovers of changes in prudential instruments (for more details, see Buch and Goldberg, 2017). Both primary sources (e.g., central bank reports) and secondary sources (e.g., the IMF GMPI survey) were used in the construction of the dataset.

<sup>6</sup> The correlations with respect to house prices are mostly not statistically significant across most countries with available data, except for a few Asian countries.

More generally, as shown in Figure 4, the correlations of LTV and both RR with countries' policy interest rates reveal heterogeneous policy actions across countries: many statistically significant correlations indicate both complementarities and non-complementarities between these prudential instruments and policy rates.

## 6.4. CONCLUSIONS

Although both summarized papers and associated datasets provide very useful descriptive statistics on the usage of macroprudential instruments as well as some preliminary evidence of their effectiveness, we still do not know how effective macroprudential policies will be, even within countries, through the economic cycle since the implementation of many macroprudential instruments is very recent. Moreover, these papers show that there is a large amount of cross-country heterogeneity in the type and number of macroprudential instruments that available to policymakers (after they are written into a law or into regulatory rules), and only a few of them (LTV and RR) seems to be actively adjusted in their intensity over-time. Further research and data are needed in order to understand the interaction of macroprudential policies with other policies (e.g. capital flow measures), the best way to implement them over the cycle (rules vs discretion), and their costs.

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## ANNEXES

Table 1. Main Regression Results

Variables	All						
	(1) - GMM	(2) - OLS	Advanced (3) - GMM	Emerging (4) - GMM	Developing (5) - GMM	Open (6) - GMM	Closed (7) - GMM
MPI	-7.637*** [1.876]	-2.112*** [0.651]	-1.376* [0.781]	-5.327*** [1.619]	-6.743** [3.076]	-2.910** [1.251]	-6.605*** [2.073]
Credit Growth	0.245*** [0.0715]	0.324*** [0.0512]	0.485*** [0.134]	0.264*** [0.0897]	0.157* [0.0872]	0.351*** [0.0869]	0.231*** [0.0798]
GDP Growth	0.399 [0.243]	0.649*** [0.144]	0.123 [0.215]	0.427 [0.288]	0.902* [0.517]	0.343 [0.226]	0.586** [0.291]
Crisis	-14.24** [6.669]	-5.967*** [1.706]	-5.781*** [1.984]	-17.07 [11.17]	4.385 [2.702]	-3.147 [2.904]	-16.47 [11.55]
Policy Rate	-1.071*** [0.340]	-0.697*** [0.196]	-0.952** [0.417]	-0.645 [0.394]	-1.389*** [0.284]	-0.544 [0.346]	-0.958*** [0.358]
Countries	106	106	31	56	19	475	58
Observations	972	972	318	525	129	452	509
AB AR(1) Test	0.00	-	0.00	0.00	0.01	0.00	0.00
AB AR(2) Test	0.11	-	0.18	0.13	0.38	0.11	0.26
Sargan Test	1.00	-	1.00	1.00	1.00	1.00	1.00

Notes: The estimates are determined using Arellano-Bond GMM treating the instrument and the control variables of credit growth, GDP growth, the crisis dummy, and the policy rate as endogenous. Column 2 is estimated through OLS. The dependent variable is real credit growth. All variables except the categorical ones are winsorized at the 5 percent level. Country fixed effects control for individual trends. The regressions are performed over the period 2001-2013. The Sargan tests' null hypothesis of over-identifying restrictions are not rejected. Arellano-Bond (AB) test for AR(1) in first differences are rejected, but not for the AR(2) test. Robust standard errors clustered by country are in brackets. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels, respectively.

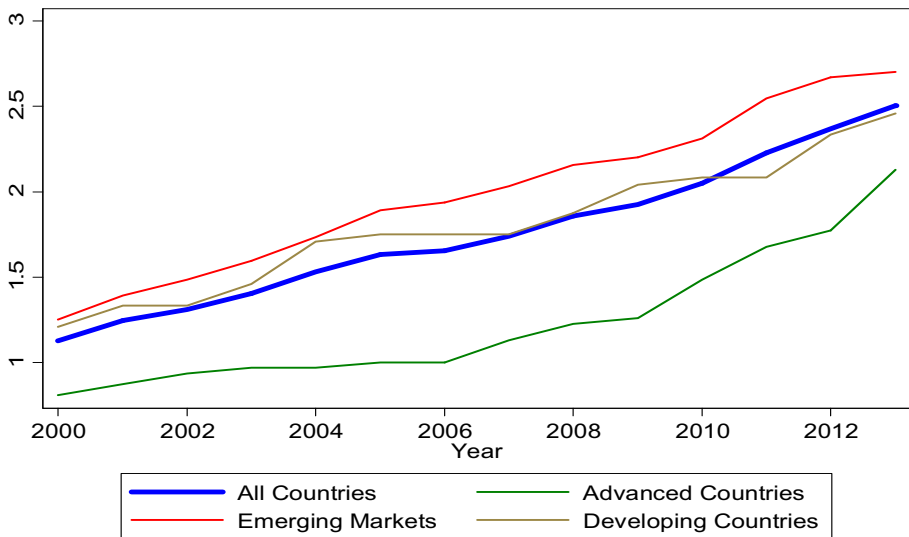
Source: Cerutti, Claessens, and Laeven (2017)

**Table 2. Intensity usage of the macroprudential indices across countries**

	Distinct countries with instrument changes	Countries with tightening episodes	Countries with loosening episodes	Countries with instrument
SSCB Real estate loans	22	20	9	64
SSCB Consumer loans	9	7	3	64
SSCB other loans	12	11	3	64
Concentration limits (CONC)	22	21	2	36
Interbank exposures (INTER)	14	13	1	22
RR foreign currency	21	20	17	64
RR local currency	46	29	44	64
Loan to value ratio limits (LTV)	36	33	14	38
General capital requirements	55	55	0	57

Notes: This table reports information on the number of countries with policy changes for each instrument. The database contains a total of 64 countries. The last column shows the number of countries with access to a given instrument at any point in time during the sample period or those countries for which we have any information.

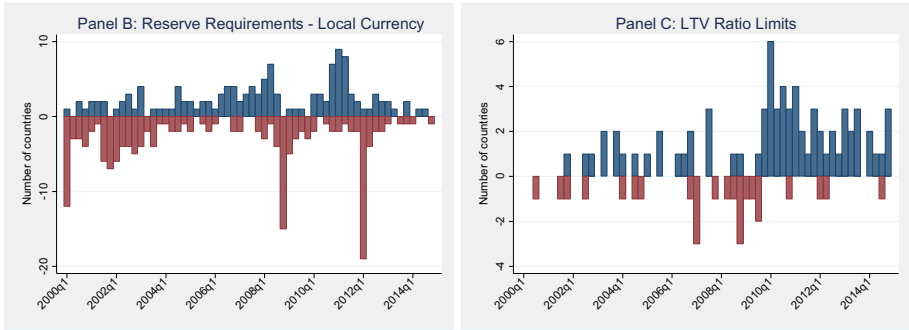
Source: Cerutti, Correa, Fiorentino, and Segalla (2017)

**Figure 1. The macroprudential policy index by income level**

Source: Cerutti, Claessens, and Laeven (2017)

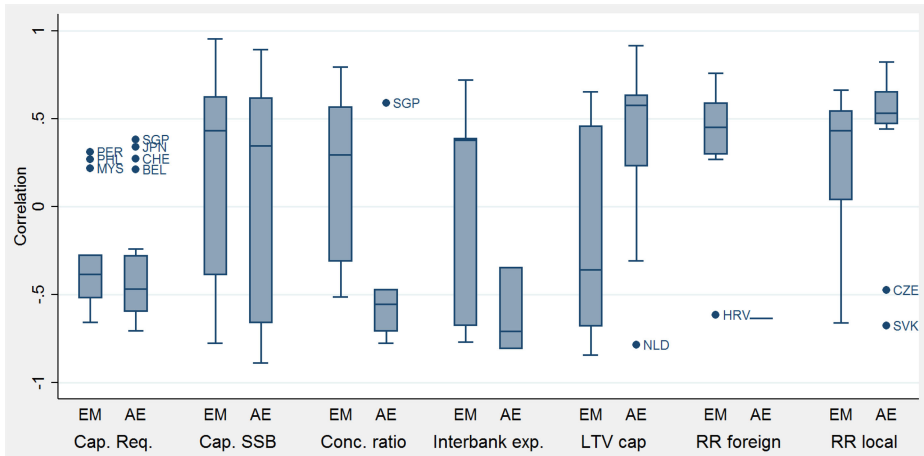


Figure 2. Changes in prudential instruments across time



Source: Cerutti, Correa, Fiorentino, and Segalla (2017)

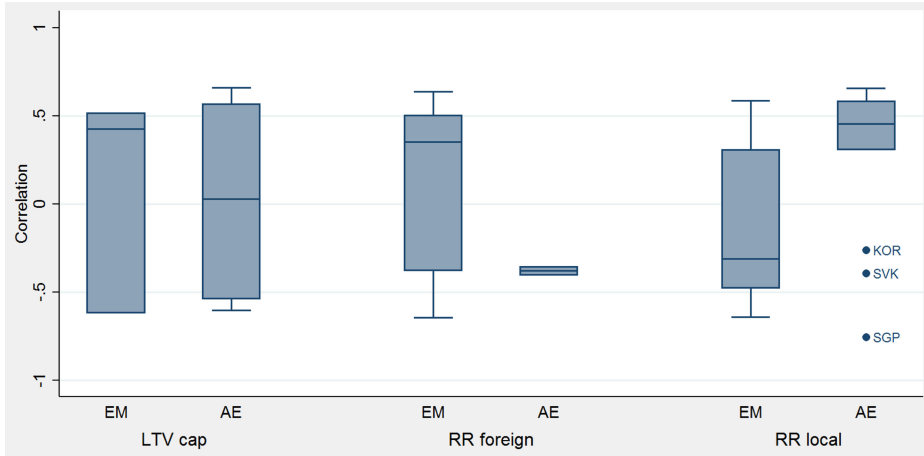
Figure 3. Distribution of correlations between intensity changes in prudential instruments and real credit growth



Note: Only statistically significant correlations at the 10 percent level or less are plotted.

Source: Cerutti, Correa, Fiorentino, and Segalla (2017)

**Figure 4. Distribution of correlation between intensity changes in prudential instruments and policy rates**



Note: Only statistically significant correlations at 10 percent or less are plotted.

Source: Cerutti, Correa, Fiorentino, and Segalla (2017)

## 7. BANK CAPITAL REGULATION IN THE PRESENCE OF UNREGULATED COMPETITIONS

*David Martinez-Miera<sup>1</sup> and Eva Schliephake<sup>2,3</sup>*

*We analyze optimal bank regulation in a setup where regulated banks are confronted with competition from unregulated institutions. The appearance of unregulated competitors alleviates the (possible) contraction in loan access resulting from stricter regulation as borrowers gain access to alternative funding sources. This effect increases optimal regulation and the welfare of the economy. In contrast, with moderate market power of banks, increased efficiency in the unregulated sector can harm welfare and result in lower optimal regulation because market power may cause inefficient lending allocation under strict regulation.*



The recent informational and technological revolution has altered the landscape of financial intermediation in many ways. One of its main impact for financial intermediation has been how it has changed how loan granting decisions can be made. The availability of new information processing methodologies and new sources of information have allowed (new) institutions to enter the financing business even in the presence of informational asymmetries that previously prevented such entities from lending. As a result, commercial banks are challenged in one of their key functions, that of firm financing.

These new lending institutions have business models that are different from the traditional bank lending models (using sources of information not used by commercial banks) and their increasing efficiency creates a threat to the business model of commercial banks. This traditional banking model is based on collecting (insured) household deposits and reallocating the funds to borrowers. In doing so, banks take advantage of the information they created during previous interactions with the borrower or even from observing the borrowers' deposit usage, which allows banks to take advantage of the market power they

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have created. The appearance of competing lenders limits the scope in which commercial banks can continue to exert their market power. This increase in competition is going to affect the amount of loans granted as well as the overall loan allocation efficiency as (some) borrowers are prone to change their financial institutions.

This paper examines how the appearance and increased efficiency of new unregulated competitors alters the optimal allocation of firm financing as well as how it changes the pre-existing competitive structure in the traditional banking sector. We study how the overall effects of an increased competitive intensity of unregulated entities depends on the competitive structure of the traditional (and regulated) banking sector.<sup>4</sup> We extract conclusions regarding the welfare effects of an increase in efficiency and the resulting implications for the optimal regulation of the traditional banking sector, focusing on capital requirements.

Although the new competitors in firm financing are different from commercial banks in many different aspects, in this paper we focus on three main differences: First, unregulated institutions are not considered as banks by regulators, and therefore do not have to comply with the same regulations as banks. Second, unregulated institutions are not funded by insured deposits but rely on funds from uninsured investors. Third, unregulated institutions are competing for customers in a different way than banks. Our crucial assumption is that the cost of (credit worthy) loan origination varies from one types of institution to another. In particular, we assume that the cost of loan financing for non-banks is constant. Banks, in contrast, present a marginal cost advantage for their closest customers but a marginal cost disadvantage for most distance customers, where the distance to the customer could reflect the length of a relationship, expertise in a certain industry of local particularities.<sup>5</sup>

We first examine the similarities and differences between unregulated institution lending business models and commercial banks. We then characterize the asymmetric competition that arises because of these differences and explore how the aggregate loan provision is determined. Taking the existence of a bank safety net and the according necessity to regulate commercial banks as given, we derive the optimal regulatory response of a welfare maximizer to an increase in the efficiency of the unregulated unregulated institution sector. In doing so we focus on how this response is affected by the competitive intensity in the regulated banking sector.

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<sup>4</sup> Another relevant aspect of the financial sector is the new consolidation wave suffer after the financial crisis which aguably limits the competitiveness of the banking sector.

<sup>5</sup> Under some particular assumptions we are able to undergo our analysis in a traditional Salop (1979) setup with slight variations.

Our results suggest that optimal capital regulation with unregulated institutions is complex and depends on the degree of regulated bank competition as well as on the relative efficiency of the unregulated entities compared to the regulated banks. As a result, the increase of efficiency of unregulated institutions can increase or decrease welfare. In response, the welfare optimizer should increase or decrease capital requirements.

When unregulated entities become more efficient their capacity to attract borrowers from banks increases. This has two effects: on the one hand it increases the financing options for entrepreneurs, which can lead to more loans being granted, but it also can distort entrepreneurs financing decisions. As unregulated institutions become more efficient entrepreneurs have the option of switching from their (more expensive) bank finance to unregulated institution finance. This switch happens because banks extract rents from entrepreneurs but is not necessarily the optimal way credit should be granted as it could be that overall the unregulated institution industry is less efficient for some of the entrepreneurs that switch and it is the rent extraction of banks what forces the switch. We show that the competitive intensity of the banking sector as well as the relative efficiency of the unregulated institution industry determine which force prevails.

We want to highlight that the potential negative effects of more efficient unregulated institutions in imperfectly competitive banking sectors is more general than our model setup.<sup>6</sup> For the ease of exposition, and in order to give an idea of the main driving forces of the model, we present the setup with capital requirements and deposit insurance as we consider them as the most discussed and, therefore, most relevant aspects of banking regulation.

The focus on understanding how the competitive structure of the banking sector affects the loan allocation the analysis of optimal regulation is shared by a long standing literature in finance.

A broad stream of literature argues that higher competition is supposed to have an adverse effect on bank stability as less bank rents increase the incentives for risk taking as discussed e.g. by Hellman et al (2000), Repullo (2004), and Allen and Gale (2004). Boyd and De Nicolo (2005) challenge this view by arguing that higher competition leaves more rents to borrowers and reduces therefore the risk of the bank's assets. Martinez-Miera and Repullo (2010) extend the Boyd and De Nicolo (2005) model and show that the impact of competition on banking stability is generally non-monotonous.

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<sup>6</sup> We base our model on an existing safety net and the resulting need for capital regulation in order to analyze the effect of unregulated institution competition on optimal bank capital requirements. However, the effect of inefficient allocation of credit supply does not depend on these assumptions. We could also focus on other types of regulations in order to analyze how to reduce the effects of unregulated institution companies on welfare and regulation.

The effect of capital regulation on bank stability is also non-monotonous for similar reasons as pointed out by Martinez-Miera (2009). In fact, Schliephake (2016) discusses that the level of competition among traditional banks may be an important moderator for the impact of regulation on bank stability.

Our study is related to a more recent literature analyzing the impact of capital regulation and its interaction with unregulated entities. Plantin (2014) analyzes the effect of capital regulation on banks' business models when they are able to create unregulated institutions (shadow banks). The optimal response to the regulatory arbitrage can be tightening capital requirements. Banks that are not bypassing regulation by shadow banking activity become very safe. At the same time stricter regulation triggers higher shadow banking activity. As a result the regulator may prefer to relax regulatory capital requirements with the result of a more fragile banking sector but also less shadow banking.

We deviate from the main setup of Plantin (2014) and analyze a setup in which unregulated banks are competitors of banks but are not necessarily owned by the banks themselves. In an extension we allow for endogenous entry into the banking sector. The setup allows us to understand different competitive pressures on the banking sector that come from non-banks and allows for novel insights regarding the welfare impact of such institutions.

Moreover, we are focusing on the asset side of the bank and unregulated bank competition, thereby allowing unregulated institutions to fulfill an important role in the economy as they fill the void that banks may leave in the loan market when they are strictly regulated.

Harris, Opp and Opp (2014) analyze a general equilibrium model where competition from public market funding alters bank lending rents and can therefore push banks into higher risk lending. This effect induces a nonmonotonic relationship between regulatory capital requirements and bank's risk taking. In an extension where we allow for bank risk shifting, our model yields similar results. However, our basic result, namely the non-monotonic relation between optimal capital regulation and non-bank competition however, is not based on higher risk taking but on constrained bank lending and lending efficiency.

To our knowledge, this is the first study that tackles how regulation should react to the existence of new unregulated competitors taking into account the competitive intensity in the banking industry.

## 8. MACROPRUDENTIAL POLICY AS AN ALTERNATIVE TO MONETARY POLICY AT THE ZERO LOWER BOUND

*Margarita Rubio and Fang Yao*

### 8.1. INTRODUCTION

In the aftermath of the financial crisis, there are new challenges to the conduct of macro-financial stabilization policies. One of the major changes in this environment is a significant and permanent decline in interest rates (Laubach and Williams, 2015). In many economies, the nominal interest rate has been close to zero and at this stance, monetary policy encounters difficulties in expanding the economy because the interest rate cannot be lowered any further. Moreover, when interest rates are persistently low, agents tend to engage in speculative investment in assets, such as real estate. Therefore, low interest rates may also contribute to asset bubbles and excessive leverage, which poses risks to financial stability (Borio, 2016).

One of the policies that has become important after the crisis is the so-called macroprudential policy, aimed at ensuring a more stable financial system. In this paper, we focus on the use of macroprudential policies in this new context in which interest rates are low. We argue that, in a low interest-rate environment, the case for using macroprudential policies becomes even stronger. On the one hand, greater financial volatility due to low interest rates calls for macroprudential policies to contain excesses in bank lending. On the other hand, macroprudential policy may also be useful to complement monetary policy when the interest rate is close to zero and cannot be used to stabilize the economy anymore.

We build an economic model for policy evaluation that can take into account that nominal interest rates are subject to a zero lower limit and cannot become negative. Within this setting, we find that when the interest rate is persistently low, both the economy and financial markets become more volatile. Therefore, we propose macroprudential policy as a natural candidate to stabilize the economy in this context. On the one hand, we find that in a low interest-rate environment, macroprudential policies, being aggressive enough can stabilize financial markets. We also find, on the other hand, that macroprudential policies could help monetary policy expand the economy in those cases in which interest rates are close to zero.

## 8.2. AN ECONOMIC MODEL FOR POLICY ANALYSIS

To evaluate the interaction between monetary and macroprudential policies at the zero lower bound, we develop a Dynamic Stochastic General Equilibrium Model (DSGE). These models have been widely used in central banks and international institutions for policy evaluation. The advantage of these models is that they are clear and simple and they permit welfare analysis and counterfactual exercises. After the crisis, they have remained being the main tool for this purpose, although they needed some updating such as the introduction of financial frictions. Models are constantly re-shaped to appropriately reflect the changes that are occurring in the economy. For instance, standard solution methods for DSGE models did not take into account the possibility of having the interest rate constrained at the ZLB, which has been proven to be a crucial feature of the economy, especially after the recent financial crisis. Large enough shocks, under these traditional methods, bring the policy rate to negative levels, violating the ZLB. However, we now know that the ZLB constraint for the interest rate is not just a theoretical curiosity, partly due to falling neutral interest rates. Even absent of large shocks, we have seen many economies across the world interest rates hitting their lower bounds. Therefore, it is important to be able to introduce this constraint in monetary policy models.

Considering occasionally binding lower bounds poses a technical challenge to solving DSGE models. In this paper, we use the solution method proposed by Guerrieri and Iacoviello (2015), namely the “occbin” toolbox, which implements a piecewise-linear approximation to solve DSGE models with occasionally binding constraints.

The model economy features patient and impatient households, a final goods firm, a central bank which conducts monetary policy, and a macroprudential authority that sets financial regulation. Households work and consume both consumption goods and housing. Patient and impatient households are savers and borrowers, respectively. Borrowers are credit constrained and need collateral to obtain loans. The representative firm converts household labor into the final good. The central bank follows a Taylor rule for the setting of interest rates, subject to the zero lower bound constraint. The macroprudential regulator uses the LTV as an instrument for macroprudential policy.

## 8.3. THE OCCASIONALLY BINDING ZLB

To illustrate how the occasionally binding ZLB affects the dynamics in our model, we compute impulse responses to a productivity shock, using both the standard solution method and the “occbin” toolkit. In this case, the LTV is set to its steady state value of 0.9 and no active rule is allowed.



Figure1: Impulse responses to a negative productivity shock

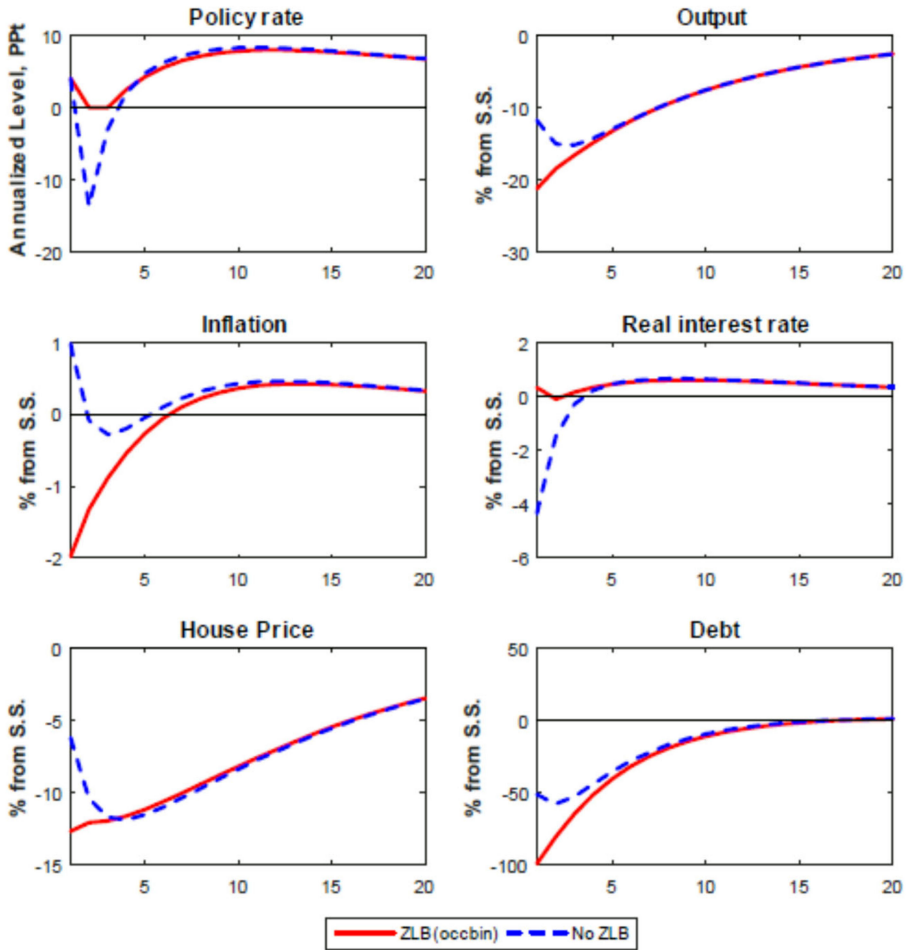


Figure 1 presents impulse responses to a negative productivity shock for the case in which the economy is not constrained by the ZLB (blue dashed line) as opposed to the occasionally binding ZLB case (red solid line).

The upper-left panel displays the annualized level of the policy rate. It starts from the steady state level of 4%. We see that, when there are occasionally binding constraints for the interest rate, the policy rate reaches the zero lower bound and stays there for a couple of periods before converging to the Taylor rule interest rate. The non-constrained interest rate, however, becomes negative. This discrepancy between the two rates makes the rest of the variables also behave differently. In particular, both output and inflation respond in a much stronger manner in the world in which the interest rate is constrained. The deeper output

recession in the occasionally binding model is driven by two channels. Firstly, the negative impact of the productivity shock is amplified by the collateral channel of borrowers, even without a ZLB. As shown in blue dashed lines, when the negative shock hits, house prices fall and tighten the collateral constraint for borrowers. This, in turn, negatively affects credit via the collateral constraint. This feedback loop between house prices and credit gives rise to a powerful financial accelerator, emphasized in Iacoviello (2005). Even though, in this case, the central bank can support the economy by cutting the interest rate dramatically, the economy suffers an output recession. Secondly, when the interest rate is restricted by the occasionally binding ZLB, the latter provides an additional amplification of the shock. In this case, the occasionally binding ZLB economy suffers an even stronger recession, because the combination of deflation and the binding ZLB of the nominal interest rate pushes up the real cost of borrowing. The rise in the real interest rate depresses house prices and credit further, triggering the collateral effect on the real economy. As shown by the red solid lines, in the occasionally binding economy, the interest rate falls to zero and stays there for a few periods. In the meantime, inflation falls sharply, pushing up the real interest rate. As a result, house prices, credit and output decrease by more than in the case where the ZLB is ignored.

With this example, we show that explicitly modelling the occasionally binding ZLB delivers an enhanced propagation mechanism via the collateral channel for both real and financial variables. The importance of the collateral channel is much greater when the steady-state interest rate is low.

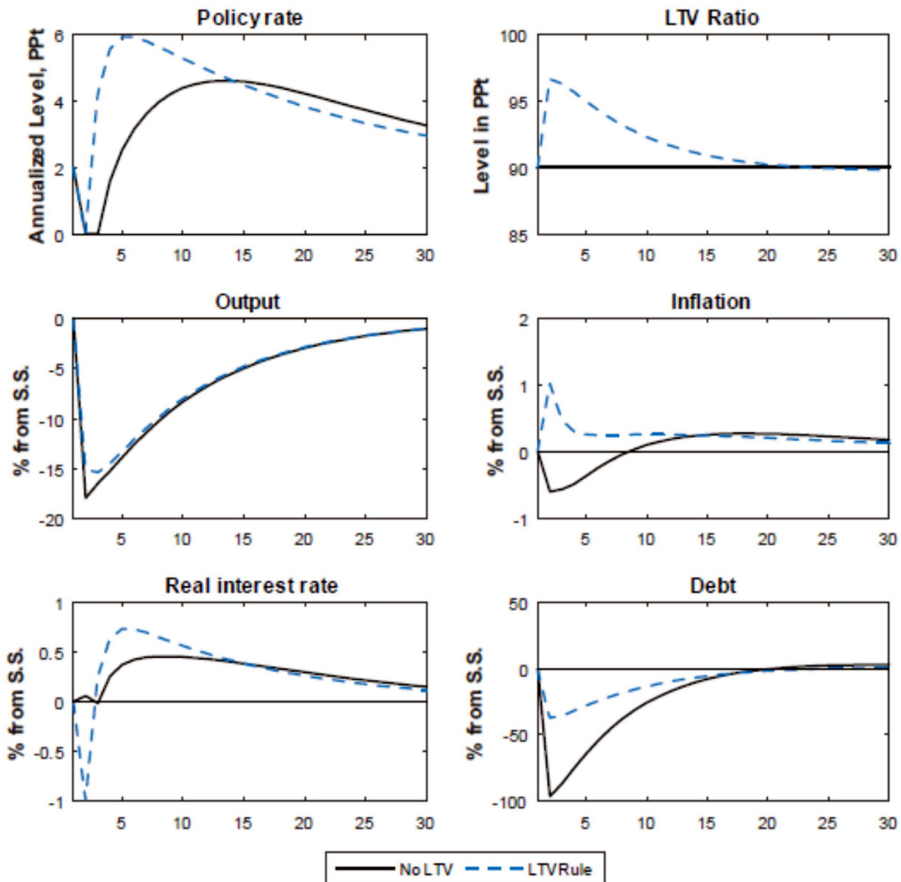
#### 8.4. MACROPRUDENTIAL POLICY AT THE ZLB

A low interest-rate environment calls for the use of macroprudential policy. On the one hand, it allows to enhance financial stability, in a world in which financial markets are more volatile. On the other hand, it can complement monetary policy to stabilize the macroeconomy, at these stances in which the interest rate hits the ZLB.

To see how monetary and macroprudential policies, figure 2 presents impulse responses to a negative productivity shock in the model with a low steady-state interest rate. We compare the benchmark scenario in which there is no active LTV policy versus the case where the LTV responds countercyclically to credit. In both cases, interest rates are restricted by the occasionally binding ZLB.

First of all, without an active LTV policy, the interest rate immediately drops to the ZLB and stays there for a few periods. The economy suffers a deep recession, where both output and inflation fall. As discussed above, the effect of a negative productivity shock is amplified by the collateral channel and the rising real

Figure 2: The effect of an active LTV rule at the ZLB



interest rate due to the binding ZLB. By contrast, when a countercyclical LTV rule can be used to help the economy, it relaxes the LTV by about 10 percentage points. As a result, the provision of credit is supported by the LTV loosening. Interestingly, under the LTV policy, the ZLB binds just for one period. This comes from the general equilibrium effect on inflation. With the support of macroprudential policy, inflation increases instead of falling, which lifts the interest rate out of the ZLB more quickly. As a result, the real interest rate falls, providing the real economy with the kind of support that would have been achieved by monetary policy, should an occasionally binding ZLB not exist.

The main message that we obtain is that, when monetary policy is limited by an occasionally binding ZLB, a countercyclical LTV rule can help to stabilize the economy by both mitigating the collateral effect and lifting the interest rate out of the ZLB.

## 8.5. EFFECTIVENESS OF MACROPRUDENTIAL POLICIES

In this section, to check for the effectiveness of macroprudential policies under the two scenarios, low and high interest rates, we compute volatilities in the credit and output space, for the high and the low interest-rate environment. This experiment resembles the computation of output and inflation volatility frontiers for monetary policy.

Figure 3: Volatility frontier

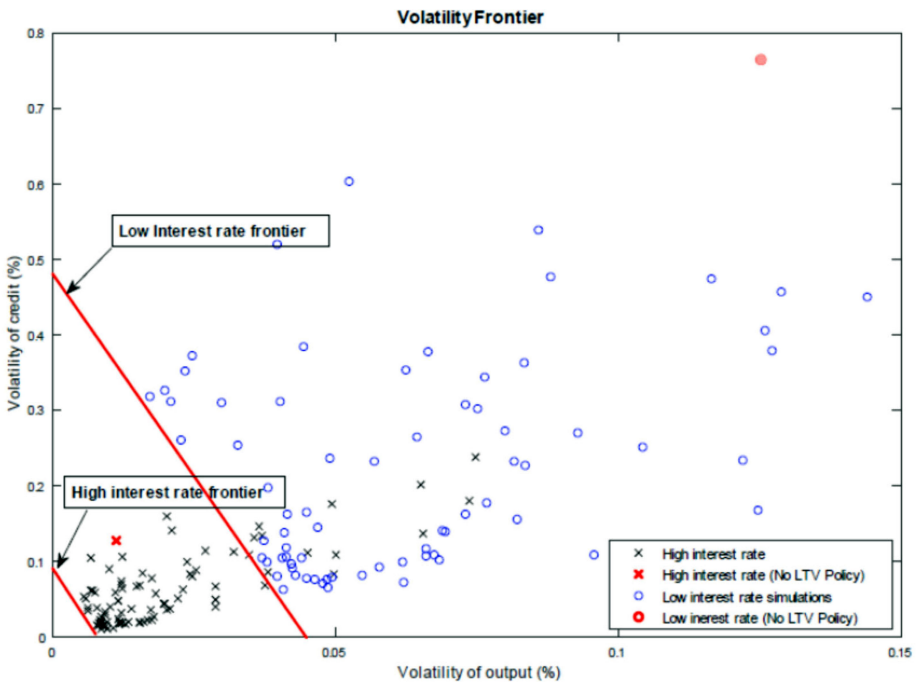


Figure 3 displays a scatter plot of the volatility of output and credit, given different LTV rule parameter values.

The black crosses correspond to volatilities obtained in the high interest-rate environment, while the blue circles represent the low interest-rate simulations. The point corresponding to simulations without LTV policy is shown in red. From the plot, two observations stand out. First, the volatility frontier in each steady-state interest-rate scenario presents a clear trade-off between output and credit volatility. This is similar to the traditional output-inflation volatility frontier for monetary policy under the presence of cost-push shocks. A stronger use of macroprudential policy would decrease the financial volatility, but increase the volatility of the real economy, and vice versa. Second, the low steady-state

interest-rate environment worsens the policy trade-off, because of the occasionally binding ZLB. It is clear from the picture that, in the low interest rate environment, the economy becomes generally more volatile, and macroprudential policy can only achieve the same level of volatility of one variable at a greater expense in the volatility of the other one. Given that the volatilities without the LTV policy are not on the frontier (scatter point in red), macroprudential policy still contributes to greater macroeconomic stability under both interest-rate scenarios, especially for the lower interest-rate environment.

## 8.6. CONCLUSIONS

In this paper, we build a DSGE model in which interest rates are permanently low and monetary policy is constrained by the ZLB. In this context, we study the implementation of macroprudential policies, represented by an LTV rule. In particular we answer the following research question: Can macroprudential policies complement monetary policy when the latter binds at the ZLB occasionally?

We find that when interest rates are persistently low, the ZLB occurs frequently, leading to greater macroeconomic volatility and financial instability. In this context, the economy calls for the use of active macroprudential policies to contain financial stability and to act as a complement to the less effective monetary policy. The main message that we obtain is that, when monetary policy is limited by an occasionally binding ZLB, a countercyclical LTV rule can help to stabilize the economy by both mitigating the collateral effect and lifting the interest rate out of the ZLB. Therefore, in this environment, macroprudential policies can act as a complement to monetary policy.

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## 9. COUNTERCYCLICAL CAPITAL BUFFERS, DYNAMIC PROVISIONS OR BOTH?

*Serafín Frache, Javier García-Cicco and Jorge Ponce*

*The aim of this article is to summarize the main results of our paper “Countercyclical prudential tools in an estimated DSGE model”, where we perform a realistic assessment of the countercyclical regulation promulgated in Basel III, and compares its relative performance with other macroprudential tools already used in many countries: dynamic loan loss provisions.*

### 9.1. COUNTERCYCLICAL CAPITAL BUFFERS AND DYNAMIC PROVISIONS

In the wake of the global financial crisis of 2008-2009 it has become clear the importance of systemic risk and the need for a macroprudential perspective to financial regulation. In this spirit, new prudential regulation has been established, being of particular importance Basel III, which strengthens bank capital and liquidity requirements. Among other things, Basel III increases minimum capital requirements, introduce more stringent liquidity regulation and introduces a counter-cyclical capital buffer. This last measure is intended to build capital buffers in booms, which may be used to (partially) absorb losses during a downturn, hence prudentially attending the cyclical and endogenous rise in systemic risk during upturns. The implementation and efficiency of these regulations has been a topic of vivid debate among policymakers and academics.

Regarding the implementation of countercyclical capital buffers, the debate is particularly relevant in jurisdictions where other macroprudential instruments developed to mitigate the procyclicality of the financial system are currently in place. For example, Spain and several Latin American countries have been using dynamic loan loss provisions as a countercyclical regulatory rule for several years.<sup>1</sup> Under dynamic provisioning a fund is accumulated in periods where the expected losses are lower than the long-run, or through-the-cycle, level. Dynamic provisions are not released in periods with low default rates, but they are used to cover losses in a downturn. For the case of Spain, Jiménez et al. (2017) find that dynamic provisioning smooths credit supply cycles and, in bad times, supports firm performance. In a formal model, Gómez and Ponce (2015) study the effec-

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<sup>1</sup> Recently, Spain stops using dynamic loan loss provisions in order to implement a countercyclical capital buffer.

tiveness of countercyclical capital buffers and dynamic provisioning to provide the correct incentives to bank managers and conclude that both of them are adequate policy tools.

How should Basel III countercyclical capital buffer be implemented or adapted in countries that already have dynamic provisioning? Which one is the most efficient prudential tool? Are countercyclical capital buffers and dynamic provisions complementary or substitute instruments? Do the source and magnitude of shocks matter to prefer one instrument over the other?

## 9.2. AN ESTIMATED DSGE MODEL

We develop a DSGE model for a small and open economy. Borrowers (called entrepreneurs) are modeled as in Bernanke et al. (1999), and can default on their loans. Banks use deposits and own capital to lend to entrepreneurs and also to buy government bonds. Additionally, the banking sector is subject to prudential regulation. We extend Bouvatier and Lepetit's (2012) dynamic provisioning framework to a general equilibrium model, endogenize the loss given default by using Bernanke et al.'s (1999) specification of default, and introduce various capital requirement rules, including countercyclical ones, as well as liquidity requirements.

The model is estimated using quarterly data for Uruguay in the period 2005Q1 to 2015Q4. Uruguay has been using dynamic loan loss provisions since 2001. Hence, this data provides a nice counterfactual for a realistic estimation of the proposed DSGE model. Finally, we perform simulations of the key macroeconomic variables and of the banking sector under different regulations in order to compare the results. More precisely, we compare the dynamics of this modeled economy with financial frictions when it is affected by external and domestic shocks under alternative macroprudential regulations: countercyclical capital buffers with alternative indicators of the financial cycle (i.e. GDP and credit) and different rules for loan loss provisioning (i.e. static and dynamic).

We model the banking sector to account for different regulatory policies and commonly observed facts in banking. In particular, banks usually maintain more capital than the minimum that is required by regulation (see Allen and Rai, 1996; Peura and Jokivouille, 2004; Barth et al., 2006; Berger et al. 2008).<sup>2</sup> Rather than strictly complying with capital regulation, banks exhibit their own target levels of capital. Depending on the extent of their capital buffer, banks will adjust their capital and risk taking to reach their target levels (Milne and Whalley, 2001;

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<sup>2</sup> For example, in the particular case of Uruguay banks hold on average between 2005 and 2015 a capital buffer equivalent to 0.6 times the minimum capital requirement.

Ayuso et al., 2004; Lindquist, 2004; VanHoose, 2008; Jokipii and Milne, 2008 and 2011; Stolz and Wedow, 2011). Our model allows bankers to maintain capital above the minimum requirements.

Moreover, we model countercyclical (dynamic) loan loss provisions by introducing the possibility of accumulating a loan loss provision reserve fund when some selected variable grow more than the historical average, thus linking provisioning to the credit and business cycles. This allows us to study the performance of different provisioning rules and assessing the relative efficiency of countercyclical loan loss provisioning and countercyclical capital buffers.<sup>3</sup>

### 9.3. MAIN FINDINGS

We perform a series of simulations for different regulatory policies in order to assess their performance. In particular, we focus on countercyclical capital requirements and on dynamic provisions. We analyze the dynamics of real and banking-related variables under different specifications of the countercyclical rules, and for alternative calibrations of their governing parameters. We analyze two positive shocks: a reduction in the country premium (an aggregate, external shock) and a reduction on the risk of entrepreneurs (an idiosyncratic, domestic shock). Together these two shocks explain most of the variance of bank capital, credit growth and entrepreneurs' default. Our goal is to assess the buffering capacity of both tools and their effects on real and financial variables.

The results suggest that both countercyclical capital buffers and dynamic provisions are effective in generating buffers than may cover future losses. However, their impact on activity and other real variables is quite different. Countercyclical capital requirements do not have major real effects. Dynamic provisions may, however, have a countercyclical impact on activity and other real variables. The intuition for this difference is as follows. While capital buffers force banks to increase capital during booms, banks can in principle reduce assets by either lending less to entrepreneurs or by lowering its holdings of other assets (e.g. government bonds). In the estimated model, banks mainly choose the second alternative, and therefore different degrees of countercyclicality in the capital-buffer rule have little impact on the real side of the economy. In contrast, loan loss provisions, by affecting directly the lending decisions by banks, can have a larger impact in smoothing the business cycle.

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<sup>3</sup> The banking sector model also includes liquidity or reserve requirements regulation, although we do not analyze the role of this instrument as a potential macroprudential tool. For an analysis of this alternative see, for instance, Glocker and Towbin, 2012.



When the economy faces a positive, external shock, a countercyclical capital rule based on real GDP growth has a quicker and stronger effect in buffering bank capital than a rule based on real credit growth. In this case, the ratio of credit to GDP decreases, which discourages the use of this variable to guide the buffering decision. In terms of smoothing the cycles, dynamic provisions seems to outperform countercyclical capital requirements under external financial shocks.

Our results are in line with those by Agénor and Zilberman (2015) who find that a dynamic provisioning regime can be highly effective in mitigating procyclicality of the financial system, and that combined with a credit gap-augmented Taylor rule it may be highly effective to mitigate real and financial volatility associated with financial shocks. A similar result can be found in Agénor and Pereira da Silva (2017). Our modeling choice, however, allows us to also assess the relative efficiency of other prudential tools like the countercyclical capital buffer. Moreover, our results are based on an estimated version of the model rather than on a generic parametrization as in these other papers.

The analysis also highlights that the source of the shock driving the boom is relevant in analyzing this policy instrument. First, we find under external shocks the dynamics of the credit-to-GDP ratio is actually procyclical, making this variable unreliable as an indicator to determine how to change capital requirements in a prudential fashion. Second, the source of the shock is relevant to calibrate the size of the dynamic provisioning (the same calibration may be too countercyclical if the shock is domestic rather than if it is external). Finally, the cycle-smoothing abilities of both policy tools depend on the source of the shock as well.

#### 9.4. POLICY IMPLICATIONS

In a small-open economy like the one that is modeled, the source of the shock matters to select the indicator variable for the countercyclical capital requirement (credit to GDP does not seem adequate under external shocks), to calibrate the size of the dynamic provisioning (the same calibration may be too countercyclical if the shock is domestic than if it is external), and to select the policy tool (dynamic provisions seems to outperform countercyclical capital requirements under external financial shocks). Overall, it seems prudent to have both policy tools available on the set of regulatory instruments.

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## 10. MACROPRUDENTIAL POLICY IN A CURRENCY UNION

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### 10.1. INTRODUCTION

Before the 2007-08 global financial crisis, many macroeconomists held the view that monetary policy would be enough to clean the consequences of future crises. After the crisis, however, many of these economists recognized that additional tools are needed to reduce the severity and probability of future crises. Several such tools are the so-called macroprudential policies, which are usually defined as a financial regulation that takes into account general equilibrium effects (Hanson *et al.*, 2011). There is a growing literature that has studied the joint design of macroprudential and monetary policies.<sup>2</sup> The present non-technical summary and its companion paper (Sergeyev, 2016) contribute to this literature by considering the design of macroprudential and monetary policies in a monetary union.

Why is macroprudential policy design in a monetary union different from one in a closed economy? It is well known that a single monetary policy tool cannot stabilize asymmetric shocks in regions of a monetary union. Various regional tools should be used to mitigate regional shocks. As a result, if macroprudential policies can vary across regions of a monetary union, they can potentially be used to mitigate regional business cycles in addition to their financial stability objective. In this project, I show how optimal regulation takes these considerations into account.

I emphasize two sets of main results. First, a financial regulator of a small open economy country that belongs to a monetary union must partly use the financial regulation tools to stabilize the country's business cycles. Second, there are gains from coordinating regional macroprudential policies that lead to unexpected results under certain conditions. For example, a globally coordinated policy should be tighter than the policy chosen in a non-coordinated fashion in severe union-wide recessions.

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<sup>2</sup> See, for example, Woodford (2011), Stein (2012), Kashyap and Stein (2012), and Farhi and Werning (2016).

## 10.2. KEY MODELING ASSUMPTIONS

Any model that attempts to study the optimal conduct of macroprudential policies in a monetary union must have the following three elements. First, there should be a role for monetary policy to start a description of a monetary union. Second, there must be a source of financial instability to allow for meaningful objectives for the macroprudential policy. Finally, to have a distinction between countries of a monetary union, one must have elements of international economics. The model that I use to study optimal macroprudential policy design features all these elements, which I summarize below.

### 10.2.1. Role of Monetary Policy

One standard method to introduce the role of monetary policy is to assume that nominal prices do not immediately respond to disturbances affecting the economy. Under this assumption, the central bank can affect real variables in the economy. For example, by changing the short-term nominal interest rate, the central bank affects the real interest rate, which is an important variable that affects the behavior of firms and consumers.

The presence of sticky prices introduces a discrepancy between the market and socially optimal allocations of resources because of the so-called “aggregate demand externality.” Intuitively, when consumers increase their demand for goods, production of these goods goes up because prices do not adjust. In aggregate, an increase in production elevates consumer income. However, consumers do not internalize that initial changes in their shopping behavior affect their and others’ income, resulting in externality.

The welfare effects of this externality can be quantified by the notion of the “labor wedge” – the difference between private marginal benefits of consumption and the marginal costs of production. Without sticky prices, the market forces equalization of the marginal benefits and costs of production, making the labor wedge equal to zero. In this case, there is no role for monetary policy intervention. With sticky prices, the labor wedge can deviate from zero. When the economy is in a recession, people consume and produce few goods leading to the higher marginal benefit of consumption and lower marginal cost of production, resulting in a positive labor wedge. If the central bank stimulates the economy by increasing aggregate output, it can increase social welfare to the point at which the labor wedge is set back to zero. Alternatively, the labor wedge is negative in booms, as the central bank increases the social welfare by reducing aggregate output (cooling down the economy).

### 10.2.2. Financial Stability

The second key element of the model is financial friction that provides a role for macroprudential policy. I follow Stein (2012) who argued that banks may issue too many safe and liquid assets because they do not internalize all the costs associated with the issuance. In Stein's model, economic agents value safe assets (cash, government bonds, repurchase agreements, etc.) above and beyond their pecuniary returns because, for example, they are useful in transactions. Faced with such a demand for safe and liquid assets, banks have incentives to fund themselves with safe assets more than with risky ones. To issue safe assets, the bankers must post longer-term risky assets (e.g., mortgages, auto and student loans, etc.) as collateral and then ensure that the resale value of this collateral in any future state of the world is enough to repay the safe debt holders. This introduces a collateral constraint featuring an endogenous asset price.

The presence of the endogenous price in the collateral constraint creates a negative pecuniary externality that macroprudential policy seeks to correct. The intuition behind this externality is as follows. By issuing additional units of safe debt, a bank creates new loans (leading to additional production of durable goods, e.g., houses) and lowers their future resale prices. This tightens the collateral constraints for all other banks because it is the future price that enters the collateral constraints and increases the costs of operating for all other banks. Each individual bank does not internalize this externality effect of its own financing choice.

In the presence of this externality, the regulator aims to limit safe asset production. One way of doing this is to introduce taxes on safe debt issuance. In this project, I follow Kashyap and Stein (2012) and Woodford (2011) who argued that reserve requirements, with interests paid on reserves, applied universally to all riskless liabilities of all financial firms, represents a tax on safe debt issuance.<sup>3</sup>

This *universal* reserve requirement resembles traditional reserve requirements and the liquidity coverage ratio, introduced in the Basel III Accord. The traditional reserve requirement policy orders banks to keep a minimum amount of central bank reserves relative to their deposits. The liquidity coverage ratio broadens the scope of traditional reserve requirements by obliging various types of financial firms (and not just traditional banks) to hold a minimum amount of liquid assets relative to various liabilities and not just deposits. The macroprudential policy tool in this project differs from the liquidity coverage ratio, in that financial firms are required to hold central bank reserves only.

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<sup>3</sup> In what follows, I will use the phrases macroprudential policy, safe debt issuance tax, and universal reserve requirements interchangeably.

### 10.2.3. International Linkages

The third key element of the model is the international linkages between countries. I assume that agents have preferences over goods that are traded internationally (traded goods) and locally (non-traded goods) as in the new open economy macro literature.<sup>4</sup> As a result, despite having a fixed nominal exchange rate, the real exchange rates will fluctuate between countries. This introduces international spillovers that financial regulators may decide to consider.

Domestic financial firms invest only in local projects (e.g., lend to local firms and households) but fund themselves on the international (union-wide) market for safe debt. This assumption approximates the functioning of the Eurozone financial sector. As a result, changes in macroprudential regulation in a given country can change economic activity in this country because the reduction in loan supply to firms and households leads to a reduction in aggregate demand and output.

## 10.3. REGIONAL MACROPRUDENTIAL POLICY

The first main result in this project characterizes the optimal macroprudential policy of a financial regulator in a small open economy that belongs to a monetary union. Specifically, I assume that the local financial regulator (e.g., the Bank of Italy) sets the universal reserve requirements applied to the financial firms operating in this country to maximize the social welfare of agents in this country. As a result, the regulator will not consider the changes in welfare in the other countries generated by international spillovers.

The key insight of this optimization problem solution is that the financial regulator not only tries to correct negative pecuniary externality in the financial sector but also tries to stabilize local business cycles due to the presence of the aggregate demand externality. Moreover, because of the presence of international linkages, there are two manifestations of aggregate demand externality and three manifestations of pecuniary externality, resulting in five forces that shape the choice of the optimal level of macroprudential policy. I summarize the intuition behind these forces next.

The first manifestation of the aggregate demand externality is identical to the one discussed earlier in Section 9.2.1. Because the monetary union central bank may decide not to close the labor wedge in a particular country, the financial regulator in this country must consider the non-zero labor wedge when optimally setting

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<sup>4</sup> See, for example, Obstfeld and Rogoff (1995), Corsetti and Pesenti (2001), and Benigno and Benigno (2003) for early contributions and Corsetti *et al.* (2010) for a recent overview.

macroprudential policy. Specifically, when the country is in a recession (when aggregate output is too low, the labor wedge is positive), the regulator has incentives to set looser regulation on the financial firms. This reduces firms' funding costs and allows them to provide more loans. In turn, aggregate demand and output increase, increasing the social welfare during a recession when the labor wedge is positive.

The second manifestation of the aggregate demand externality is due to the presence of another fixed price – the fixed nominal exchange rate in a currency union. The law of one price and the membership in a currency union require that the nominal prices of internationally traded goods are the same across countries. As a result, these prices are fixed from the perspective of the small open economy member of the currency union. The externality works as follows. When a bank issues more safe debt, part of it is sold internationally in exchange for traded goods. However, because the relative price of traded to non-traded goods is not flexible, the only way for local consumers to absorb higher quantities of traded goods is to also increase their consumption of non-traded goods. If this does not occur, the consumers do not act optimally. Higher consumption of non-traded goods increases their production. The local financial firms do not internalize this effect, resulting in externality. In recessions, the macroprudential regulator has incentives to loosen its regulation even more to boost aggregate output (and bring the labor wedge closer to zero) because of the presence of this externality.<sup>5</sup>

The first manifestation of pecuniary externality is identical to the one discussed earlier in Section 9.2.2. The local financial regulator aims to limit the production of safe assets by imposing tighter reserve requirements. However, because of the international spillovers, the behavior of each individual bank affects all other banks and consumers in the small open economy through additional channels.

To understand the two additional pecuniary externalities that a financial regulator must address, imagine that a financial firm issues some additional amount of safe debt. Part of it is bought on the international market for traded goods. Although, as discussed above, this increases the current consumption of traded goods in the small open economy, the future consumption of these goods falls as financial firms will have to repay safe debt sold to foreigners with traded goods. This will increase the price of traded goods relative to non-traded goods in the future.

In turn, this affects other financial firms and consumers, resulting in two distinct effects. First, a higher future price of traded goods reduces the future value (in terms of traded goods) of banks' collateral, leading to a tightening of their

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<sup>5</sup> Farhi and Werning (2012) use similar externality to justify a role for fiscal transfers across members of a currency union.



collateral constraints. Each individual bank does not internalize this effect, creating a (negative) pecuniary externality that the regulator aims to correct by tightening reserve requirements.<sup>6</sup> Second, a higher future price of traded goods allows the consumers to buy more non-traded goods for a given consumers' holdings of safe assets (expressed in units of traded goods). This results in a positive pecuniary externality that financial firms do not internalize. Because of this externality, the financial regulator has incentives to loosen macroprudential regulation.

To summarize, when a local financial regulator independently sets macroprudential policy in a small open economy that belongs to a currency union, the regulator must trade off the effects of five externalities, two of which arise from sticky goods prices and three from endogenous asset prices in the collateral constraints.

#### 10.4. COORDINATION OF REGIONAL MACROPRUDENTIAL POLICIES

The second main result in this project characterizes the gains from coordination of local macroprudential policies. Specifically, I solve for the optimal behavior of a global financial regulator who maximizes a weighted average of social welfare in every country by setting local reserve requirements. As a concrete example of such a situation, one can imagine that all local financial regulators in the Eurozone allow the global regulator (e.g., the European Central Bank) to set local macroprudential policies.

A global regulator solution will internalize international spillovers of regional policies. There are three sources of international spillovers in the model. The first spillover arises from a fixed nominal exchange rate and sticky goods prices. Specifically, a tighter regulation in country  $i$  reduces production of non-traded goods in the other currency union members. Intuitively, a tighter regulation in country  $i$  reduces financial firms' issuance of safe debt in this country, leading to a drop in the union-wide safe real interest rate.

There are two consequences of this. First, agents in the other countries want to save less, hence, they increase their current consumption of traded goods. Second, because monetary policy does not fully respond to this development, the current price of traded goods falls. The fall in the price of traded goods is larger and, as a result, the total spending on traded goods falls. Optimal behavior of households implies that they must cut down on non-traded goods spending. The only way to

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<sup>6</sup> This externality underlies recent, growing literature on prudential capital controls (see, e.g., Bianchi, 2011).

do that is to decrease real non-traded consumption because the prices of non-traded consumption are fixed. This all leads to a decline in aggregate demand in every country. Countries already in recession will experience a decline in welfare, while booming countries will gain from this spillover.

The other two spillovers arise because a tighter macroprudential policy in country  $i$  reduces the price of traded to non-traded goods in all other countries of the union. Intuitively, by reducing the issuance of safe debt by banks, a tighter macroprudential policy in country  $i$  shifts traded consumption from today to the future, and from the future to today in the remaining countries in the monetary union. Lower consumption of traded goods in those countries increases the prices of traded to non-traded goods. This tightens collateral constraints of the banks in those countries and increases amount of goods that households can buy with safe assets. These spillovers onto financial firms and consumers of countries other than  $i$  represent negative and positive spillovers that the financial regulator of country  $i$  does not internalize when setting the policy independently.

## 10.5. CONCLUSION

In this project, I solved for the optimal macroprudential policy in a monetary union and characterized the externalities that financial regulators seek to correct. There are two main findings. First, the local regulator must consider international linkages and the state of the local business cycle when setting the optimal policy. Second, there are gains from coordinating macroprudential policies across countries. These gains depend on the economic conditions in the countries of the monetary union.

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## 11. SCHÄUBLE VERSUS TSIPRAS: A NEW-KEYNESIAN DSGE FOR THE EUROZONE DEBT CRISIS

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### 11.1. INTRODUCTION

The Eurozone has experienced a major sovereign debt crisis past 2009. Greece, then Ireland and Portugal lost their access to the financial markets and had to request financial assistance from the other Eurozone countries. Then it was the turn of Spain, and to a lesser extent of Italy (in the summer of 2011) to experience huge spikes in their financing rates. Greece eventually wrote down more than 50% (in face value term) of its public debt.

What happened? Two shocks of a different nature actually hit the Eurozone countries which came under stress. The Greek shock resulted from the sudden discovery of a major deficit of the public sector in 2009. After many revisions, it reached the almost unprecedented level of 15.5% of GDP. The speed at which such a deficit could be brought down to normal was clearly finite and became the root of Greece's problems. In the case of Ireland, the issue was more straightforward. The banking crisis saddled with debt a country which was viewed as perfectly solvent (respecting all the criteria of the Maastricht treaty with honors). Here a major unexpected shock on debt created the crisis.

Although relatively simple to describe and analyze in retrospect, these two polar cases do not fit well the literature on sovereign debt. For one thing, in most models, the primary surplus is a "control variable", i.e. one that government can monitor at will. Clearly, as the Greek case demonstrated, there are limits to the speed at which the primary deficit can be contracted. Although these costs to adjust the primary surplus can be taken into account in a model à la Arellano (2008) by introducing an adjustment cost on any debt changes, in our model preferred habit will reduce endogenously the speed of adjustment. One contribution of this paper is to model explicitly how these limits can be accounted for.

Another dimension of the Eurozone crisis is the discontinuous break in the debt-to-GDP ratio. Because of the banking crisis, the Irish government suffered from a huge jump in its public debt. This changed the dynamics of debt accumulation, in ways standard models do not usually account for. Usually the debt builds results from a country (willingly) running excessive deficits. The risk of a discrete jump is another feature that we want to embed in our model.

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<sup>1</sup> Co-authored with Daniel Cohen (PSE, CEPR) and Sébastien Villemot (OFCE).

We analyze a simple DSGE model in the spirit of Smets and Wouters (2003). We analyze how the risk of default evolves, in each of the three polar cases: in a flexible exchange rate regime, in a Eurozone case (fixed exchange rate, with full capital mobility) where the country switches to a flexible economy if it defaults, and in a Eurozone case where the country stays in the zone whatever happens. We then turn to analyzing the consequence of an unexpected shock to either the deficit or the debt ratio. We calibrate how much unexpected debt or deficit a Eurozone country can take. We discuss the impact of a certain rigidity of the economy, namely the degree of habit consumption, as it increases the persistence of a shock. We then analyze the speed at which the debt can be reduced.

## 11.2. QUANTIFYING DEFAULT RISK IN A DSGE MODEL

The main objective of this model is to bring the literature on sovereign default and DSGE models back together: although models of default à la Eaton and Gersovitz (1981) allow value function comparison and endogenise the default decision, they cannot afford more than two state variables; on the other hand, DSGE models are unable to endogenise the default decision, and are therefore forced to introduce sovereign spreads as a proxy for sovereign risk.

In line with Mendoza and Yue (2012) who solve an RBC model with fully endogenous default, and with Villemot (2012) who solves a RBC model with default frequencies, we propose another strategy for filling the gap between these two classes of models by introducing default risk in a more complex New-Keynesian DSGE model: we compute an out-of-model value function corresponding to the one the country must face in case of default and compare it to the one the country faces in the DSGE model without default. In this way, we can compute an ex post default probability, at the cost of an approximation: the risk of default is not internalized by agents before it has materialized.

The model framework is quite standard. It depicts a small open economy in which optimizing households consume, supply labor and invest in physical capital. Firms produce using labor, capital and imported goods. We account for both nominal rigidities (good prices, wages) and real rigidities (consumption habit, investment cost). We model a fiscal authority facing a debt rule; government debt can be held both domestically and abroad.

To model sovereign default decision, we consider a satellite model whose purpose is to quantify the risk of default in the core model (i.e. before default) and compute a default frequency. Indeed, because of algorithmic and computational limits, it is not possible to introduce endogenous default risk in such a model. Using a satellite model allows us to quantify an implied risk of default delivered by our DSGE model, at the cost of some approximation: default in this model is

not endogenous, as incorporating the default risk would raise the dimensionality of the model one step too high. In particular, there is no endogenous risk premium here, which is calibrated and ad hoc. Nonetheless, it allows us to compute default probabilities on simulated paths.

As in the canonical endogenous default model à la Aguiar and Gopinath (2006), we assume that, after a default on its external debt, a penalty is imposed on the country in the form of a proportional cost to production, and that the country remains in financial autarky for eternity; as a consequence, the country forgoes all the benefits, in the form of additional investment finance and consumption smoothing, offered by borrowing abroad.

The model is divided in three different features: first, we depict a baseline economy in which change is flexible (free float) and the country has its own independent monetary policy; second, we depict a country being part of a currency union, facing an exogenous monetary policy and with fixed exchange rate: if the country defaults, it is ejected from the zone, regains its monetary policy and faces a free float again (Schäuble case); third, we depict a country being part of a currency union and which is allowed to stay in the zone after a default (Tsipras case).

In all three cases (Flex, Schäuble, Tsipras), the financial autarky in the satellite model implies that external debt remains zero, which in particular means that the trade balance must be equilibrated at all times (imports must be matched by exports). In the Flex and Schäuble cases, the country has control over its monetary policy (through a Taylor rule), and the nominal exchange rate plays the role of the adjustment device.

In a nutshell, exchange rate and monetary regimes after default are the following:

- Flexible case: the model does not change after default; the country remains in a flexible exchange rate regime and has its own independent monetary policy.
- Schäuble case: the country goes back to a flexible exchange rate regime after default, and hence regains its independent monetary policy.
- Tsipras case: the country remains in the monetary union after default (and hence adjustment through the exchange rate is not possible) and in financial autarky (and hence adjustment through external debt is no longer possible). In the modelisation, something has thus to give in, and I choose to make adjustment through the nominal interest rate, which is not fixed by the ECB because of autarky but neither freely adjustable through a Taylor rule. Another possibility (to be explored) is to allow adjustment through prices by dropping the fiscal rule; this solution may be more realistic since it implies import rationing from the default country.

### 11.3. BENCHMARK RESULTS

We base our calibration on Smets and Wouters (2003) for the DSGE inputs, Mendoza and Yue (2012) for the international economics inputs and on Aguiar and Gopinath (2006) for the default specificities. Consequently, the external debt target is calibrated as to match the default threshold obtained by Aguiar and Gopinath (2006), which is approximately 30% quarterly. The calibration is quite standard for both default and New-Keynesian DSGE models. As in Smets and Wouters, we calibrate consumption habit around 0.8 for the Euro area. Our discount factor must be high in order to keep a targeted inflation around 2% in annual terms. We also calibrate the total debt target and the speed of convergence to match Maastricht criteria: a debt target ratio at 60% annual and 20 years needed to get back to it.

The first results arise from welfare comparisons in the core and post-default models. Post-default seems to be preferred in a monetary union, bringing stability for output. Indeed, in a flexible regime, there is a noise on the exchange rate that the central bank cannot handle in our model by intervening directly on change markets; the fixed regime is thus more stable, especially after a default.

Regarding default occurrences and debt thresholds, we can see that the default threshold is very high in either the Flexible, Tsipras and Schäuble models, and consequently the implicit default probability is almost zero (see Table 1). These results are much more realistic than standard default models, even if these results owe to the fact that the country does not internalize the risk of default and its corresponding cost, and should therefore not be taken at face value. Nonetheless, internalizing the risk of default would then change little to the results (except if the country were to deliberately seek to default, which is unlikely).

Table 1 – Default probabilities and debt thresholds (annual frequency)

	Default probability	Default threshold
Baseline (flexible)	0.2%	55.8%
Schäuble case	0.0%	92.3%
Tsipras case	2.88%	91.5%

In the Tsipras model instead, there is a positive risk of default, which is the outcome of the fact that default is not too costly: defaulting while maintaining the fixed exchange rate regime (barring only the ability to borrow) is not as costly as in the other cases. The reason has to do with the fact that the country regains its monetary policy while keeping the stability brought by the fixed regime.

## 11.4. THE KEY ROLE OF CONSUMPTION HABITS

Consumption habit has a remarkable influence on the risk of default. In the FLEX model, a high degree of habit raises the default threshold and lowers the default probability. In the Tsipras model the opposite effect emerges. A higher degree of consumption habit simultaneously raises the debt ceiling and the risk of default. Finally the Schäuble model is a combination of both cases. Higher consumption habit means more debt and less default risk.

The intuition behind these results comes as follows. The higher the consumption habit parameter  $h$ , the lower the volatility of consumption (almost three times higher in the low  $h$  case than in the high  $h$  scenario, for all models). As  $h$  rises, two conflicting forces operate. As the desired volatility of consumption falls, the debt is reduced to stabilize consumption. But on the other hand, a higher stock of debt service hampers the ability to respond to a (large) negative shock on GDP. This is why all combinations are possible: rising debt threshold cum rising default risk, declining debt threshold cum declining risk or rising debt and declining risk.

Specifically, *ceteris paribus*, default, when it reduces the number of instruments is less likely for large  $h$  values. The reason why this is not the case in the Tsipras case is, as we indicated earlier, that default allows the country to regain full control of its monetary policy without having to pay the consequences of exchange rate volatility. Default then becomes more likely when  $h$  rises. Schäuble is the worst of both cases, so that the risk of default does decline as in the Flexible model, but sustainable debt is also higher as the cost of default becomes even higher.

Additionally, habit consumption makes wealth cut by  $h$  which gives little leeway when  $h$  rises. This has mainly two consequences. First, when a negative shock occurs, it has less impact on agents' welfare since  $h$  is large and so the shock will hit them in a lagged and smoothed way (more persistence). As the agents feel poorer, debt is less volatile and agents come through the crisis easier. Second, it matters when a default choice has to be made. In the Eurozone after a default, the country does not need this leeway to adjust in case of a GDP shock, since stability prevents you from adverse shocks. After a default in a flexible regime, degrees of freedom are however needed. This implies that if  $h$  is small, the country has enough leeway to go out of the zone and regain your monetary independence: the country will prefer Schäuble rather than Tsipras. We can thus derive a theorem: in a monetary union and if habit formation is sufficiently high ( $h > 0.45$ ), if you give a country the choice between (i) default and leave the zone and (ii) default and stay in the union, it will always choose (ii), default and stay. This results is reversed in case of low habit persistence ( $h < 0.45$ ).



## 11.5. POLICY TOOLS ANALYSIS

We now analyze the sensitivity of the default risk to the aggregate debt. We find the same kind of qualitative opposition between the three regimes. Raising the long run debt target does not rise (in the range that is considered) default risk in both Flexible and the Schäuble model, but does so in the Tsipras case. The intuition is the same as in the previous section. With a large habit parameter (0.85 here), the Eurozone country is more likely to default, as it seeks to regain its monetary instrument. The larger the debt ceiling the more likely it will choose to do so. The flexible and the Schäuble models generate no default, *ceteris paribus* because of the fear the additional instability brought by the flexible exchange rate regime when it is not compensated by an access to financial markets.

As a last exercise, we present sensitivity results to the speed of convergence in the fiscal rule. For large consumption habits ( $b=0.85$ ), in all cases, a fast speed of convergence does not change the default probability but reduces the debt threshold. With low consumption habits, raising the speed of fiscal convergences reduces the default risk in flexible and Schäuble models but does not affect it in the Tsipras case. Indeed, rising up the speed of convergence limits the risk that the country will err in the side of too much debt, as it is very volatile, and hence reduces the risk of default in the Flexible and Schäuble regimes. Nonetheless, we can see that the quantitative effect is very small, so this result has to be qualified; furthermore, with weak fiscal instruments, the risk of default is larger for large habit persistence in Flexible and Schäuble cases and may explain why tougher fiscal rules are here needed. In the actual Greek case, *i.e.* Tsipras framework, increasing the speed of convergence has no effect on default risk.

## 11.6. CONCLUSION

Calibrating a New-Keynesian DSGE and using the comparison of two value functions to compute an implicit default probability, we have compared the robustness of a small Eurozone in a fixed exchange rate model to a flexible rate economy. The model that we have presented highlights the critical differences between a small open economy within the Eurozone and a flexible exchange rate economy. Furthermore, analyzing the role of consumption habit persistence in three frameworks (a flexible case, a Schäuble case where the country goes out of the monetary union if it defaults, and a Tsipras case where the country stays in the monetary union even if it defaults), we were able to find a Schäuble theorem: in a monetary union and if habit formation is sufficiently high, if you give a country the choice between (i) default and leave the zone and (ii) default and stay in the union, it will always choose (ii), default and stay. This result is reversed in

case of low habit persistence. This can be explained by both stability brought by the Eurozone in terms of currency noise and persistence in negative shocks brought by large habit parameters, which make the country like even more the stability.

For the conventional set of parameters the risk of default is larger in the Eurozone case when the country can maintain its fixed exchange rate regime after defaulting. This is somehow what happened to Greece: leaving the Eurozone and simultaneously losing access to the financial markets, on the other hand, would have been too costly.

Last, we have shown that the impact of fiscal policies may change from one framework to the other: a fast speed of consolidation in fiscal rules can help preventing defaults, but only if habit persistence is low and in flexible and “Grexit” framework. In the Greek case (Tsipras), this model thus show that imposing a faster speed of fiscal convergence was not relevant for preventing the country from another default.

Two main issues can extend this work: first, we could incorporate the possibility of redemption after default, which is more realistic than our forever exclusion from borrowing (as recently showed by the Greek reentry on financial markets). Second, we could allow default on total debt rather than on external debt only; this would allow us to calibrate the model for other Eurozone countries where domestic debt is majority (Italy for instance).

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