The New Banking Regulation in Basel III: Welfare Effects and Optimal Implementation

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Abstract

In this paper, we take as a baseline a dynamic stochastic general equilibrium (DSGE) model, which features a housing market and a financial intermediary, in order to evaluate the welfare and macroeconomic effects of the new banking regulations in Basel III. We analyze the increase in capital requirements as well as the counter-cyclical capital buffer that the new regulation implies.To incorporate this buffer, we propose a macroprudential rule in which capital requirements respond to credit growth, output and housing prices. We find that the optimal implementation of Basel III is counter-cyclical for borrowers and banks, the agents directly affected by capital requirements, while pro-cyclical for savers. From a normative perspective, we see that the macroprudential component of Basel III delivers higher welfare for the society than a situation with no regulation.

Keywords: Basel I, Basel II, Basel III, banking regulation, welfare, banking supervision, macroprudential, capital requirement ratio, credit

JEL Classification: E32, E44, E58

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"*The financial crisis brought home the lesson that financial stability could not be assured only through the use of microprudential tools. And so Basel III represents another important step in the Committee's development. Basel III has substantially enhanced the microprudential framework. And, in the countercyclical buffer, it has also introduced the first international agreement on a macroprudential tool*". Stefan Ingves, Chairman of the Basel Committee on Banking Supervision and Governor of Sveriges Riksbank, at a symposium to mark 25 years of the Basel Capital Accord: 25 years of international financial regulation: Challenges and opportunities, Basel, 26 September 2013.

1 Introduction

The current crisis has taught us that a necessary condition for growth, technological and scientific advances, and innovation is to have a stable economic and financial environment. The crisis has reduced the confidence of citizens on the banking sector, key for investment and development. In order to restore this confidence and stabilize the financial sector, policy makers are proposing some reforms and new regulations on banks and financial intermediaries. A very important package of regulations is the so-called Basel III. Basel III is a comprehensive set of reform measures in banking regulation, supervision and risk management. It was developed by the Basel Committee on Banking Supervision (BCBS) at the Bank for International Settlements (BIS), to strengthen the banking sector and achieve financial stability. Furthermore, some of the new measures that Basel III introduces are aimed at preventing future crises, creating a sound financial system in which financial problems are not spread to the real economy. Preventive measures acting in this direction are known between researchers and policy-makers as "macroprudential policies."

The BCBS aims at providing some guidance for banking regulators on what the best practice for banks is. Its standards are accepted worldwide and are generally incorporated in national banking regulations. Basel I, signed in 1988, was the first accord on the issue. Basel I primarily focused on credit risk: banks with international presence were required to hold capital equal to 8 % of the risk-weighted assets. However, Basel I was soon widely viewed as outmoded because the world had evolved as financial corporations, financial innovation and risk management had developed. Therefore, a more comprehensive set of guidelines, known as Basel II were introduced. Basel II, initially published in June 2004, was intended to create an international standard for banking regulators to control how much capital banks need to put aside to guard against the types of financial and operational risks banks and the whole economy face. Nevertheless, since the beginning of the international financial crisis in 2008, central banks all over the world worked on figuring out its reasons and the points of weakness in Basel II accord that was supposed to prevent the occurrence of such a crisis. Hence, the BCBS issued a new agreement in 2010 known as the Basel III Accord concerning the minimum requirements for capital adequacy to face the financial crisis. Basel III introduces an additional capital buffer (the capital conservation buffer) designed to enforce corrective action when a bank's capital ratio deteriorates. It also adds a macroprudential element in the form of a countercyclical buffer, which requires banks to hold more capital in good times to prepare for inevitable downturns in the economy (Basel III^{MP} for future reference). Then, Basel III^{MP} keeps the 8% capital requirement of Basel I and II but also introduces a mandatory capital conservation buffer of 2.5% plus a discretionary countercyclical seasonal buffer, which allows national regulators to require up to another 2.5% of capital during periods of high credit growth. In this way, Basel III^{MP} tries to achieve the broader macroprudential goal of protecting the banking sector from periods of excess credit growth. Then, although the minimum total capital requirement will remain at the current 8% level, yet the required total capital will increase up to 10.5% when combined with the conservation buffer.

However, the way to implement this macroprudential component of Basel III^{MP} has not been specified by the Committee. Given that this reform is extremely important in terms of its scope and time horizon, it is crucial to do research on the topic to anticipate and quantify its effects and design the best possible implementation of the policy. In particular, researchers should focus on studying the effects of this new regulation on economic growth and welfare in order to appropriately find the way to implement it. The amount by which the capital requirement should be increased or decreased, the timing of action and the interaction of this reform with other existing policies is definitive in the success of failure of this new regulation. All the efforts should be make in order to guarantee that these reforms succeed, since that would bring a bright future economic outlook for the whole world. A context of stability, growth, innovation and investment, in which deep crises are avoided, is something that is definitely desirable.

In this paper, we perform a comprehensive analysis of the effects of Basel III both on the dynamics of the economy and on welfare. Furthermore, we propose an optimal way to implement Basel III^{MP}, in the sense that welfare is maximized.

In order to achieve our research goals, we build a dynamic stochastic general equilibrium model (DSGE). The advantage of using this kind of models is that, since they are general equilibrium, they can account for the interactions of all the relevant variables in the economy. They are dynamic, and therefore the effects of different shocks can be studied. They rely on deep parameters and are thus free from the Lucas critique, allowing to analyze counterfactuals and do policy evaluation. And finally, since they are microfounded, they are suitable for welfare analysis.

The model features borrowers, savers, and financial intermediaries. The reason for splitting households into borrowers and savers is that in this way, in equilibrium, credit is not zero as in a representative agent problem. Borrowers are constrained in the amount they can borrow while banks are constrained in the amount they can lend, that is, they have a capital requirement ratio. We study first how capital requirements affect dynamics and welfare. We observe that higher capital requirements decrease the quantity of borrowing in the economy and that reduces borrowers and banks consumption. In terms of welfare, savers and bankers are better off if capital requirements increase, while borrowers are worse off.

Then, we propose a macroprudential rule for the capital buffer of Basel III (Basel III^{MP}). Authorities are free to emphasize any variables that make sense to them for purposes of assessing the sustainability of credit growth and the level of system-wide risk. Some examples of other variables that may be useful indicators are asset prices, GDP, credit condition indicators. Then, along these lines, we propose a countercyclical macroprudential rule in which capital requirements respond to credit growth, output and housing prices and compute the optimal parameters that maximize welfare. Following this rule, capital requirements would respond to credit growth, output and house prices. We find the optimal parameters of the rule that maximize welfare. Our results show that the capital requirements imposed by Basel I, II and III do not deliver higher welfare for society than a situation without regulation. However, an optimal implementation of the macroprudential component of Basel III^{MP} is welfare improving. Furthermore, we find that the optimal implementation of Basel III^{MP} is counter-cyclical for banks and borrowers, the ones directly affected by capital requirements, while pro-cyclical for savers.

The rest of the paper continues as follows. Section 1.1 makes a review of the literature. Section 2 presents the modeling framework. Section 3 displays simulations. Section 4 studies welfare. Section 5 analyzes the optimal implementation of Basel III^{MP}. Section 6 concludes.

1.1 Related Literature

Although there is a general consensus about the need of macroprudential policies, the effects of them on the economy are still unclear. These policies are in the process of being designed and we do not have many examples yet. They are still proposals which have not been yet implemented. Thus, given the novelty of this perspective and the uncertainty about its effects, the literature on the topic, albeit flourishing, is also quite recent and full of gaps that need to be filled. Borio (2003) was one of the pioneers on the topic. He distinguished between microprudential regulation, which seeks to enhance the safety and soundness of individual financial institutions, as opposed to the macroprudential view which focuses on welfare of the financial system as a whole. Following this work, Acharya (2009) points out the necessity of regulatory mechanisms that mitigate aggregate risk, in order to avoid future crises. Brunnermeier has done extensive work on the topic. For instance, Brunnermeier et al. (2009) suggests that all systemic institutions should be subject both to micro-prudential regulation, examining their individual risk characteristics, and to macroprudential regulation, related to their contribution to systemic risk.

The literature has proposed several instruments to be implemented as a macroprudential tool. A complete description of them appears in Bank of England (2009) and (2011), or Longworth (2011). However, only some of them have been analyzed in depth. Among the most popular proposed instruments we can find limits on the loan-to-value ratio (LTV). The LTV reflects the value of a loan relative to its underlying collateral (e.g. residential property). Kannan, Rabanal and Scott (2012) examines the interaction between monetary and a macroprudential instrument based on the LTV. Rubio and Carrasco-Gallego (2014a) evaluates the performance of a rule on the LTV interacting with the traditional monetary policy conducted by central banks and they find that introducing the macroprudential rule mitigates the effects of booms on the economy by restricting credit. Also, they show that the combination of monetary policy and the macroprudential rule is unambiguously welfare enhancing. Rubio and Carrasco-Gallego (2014b) studies a macroprudential policy based on the LTV and finds that using this policy together the monetary policy leads to a more stable financial system.

Borio (2011) states that several aspects of Basel III reflect a macroprudential approach to financial regulation. Nevertheless, contrary to the studies already mentioned, Basel III regulation focuses on another macroprudential tool, on limits on capital requirements. However, there is some controversy around this regulation that has been pointed out by the literature. In particular, some concerns have been raised about the impact of Basel III reforms on the dynamism of financial markets and, in turn, on investment and economic growth. The reasoning is that Basel III regulation could produce a decline in the amount of credit and impact negatively in the whole economy. Critics of Basel III consider that there is a real danger that reform will limit the availability of credit and reduce economic activity. Repullo and Saurina (2012) shows that a mechanical application of Basel III regulation would tend to reduce capital requirements when GDP growth is high and increase them when GDP growth is low. Then, if banks increase capital requirements during the crises, credit will be reduced and the economic growth will be even lower; with a lower growth, the welfare would decrease. This is the so-called risk of pro-cyclicality, that is, Basel III could cause a deeper recession in bad times and a higher boom in good ones. Furthermore, it could have an adverse impact on growth plans of the industry, as pointed out by Kant and Jain (2013). If capital requirements ratios increase, households and industries could not borrow as much, and their plans for recovery would be affected, affecting the whole economy. Some authors have attempted to evaluate the effects of capital ratios such as Angeloni and Faia (2013) and Repullo and Suárez (2013). They compare the pro-cyclicality of Basel II and Basel I, the previous frameworks. They find that Basel II is more pro-cyclical than Basel I. That means that probably the newer regulation of Basel III, with even higher capital requirements ratios would boost the recession in the case that the economy is in a crisis. In our paper, we add to the discussion by comparing impulse responses for the different regulations. We find that the pro-cyclicality only appears for savers.

However, a complete welfare analysis including economic and financial stability of the new regulatory framework as a macroprudential policy is still pending for Basel III as well as finding the best way to implement the regulation. In this paper we propose an optimal implementation of this new regulation, based on a simple rule that is optimally implemented to maximize welfare. The main novelty of our paper lies on this side.

2 Model Setup

The economy features patient and impatient households, bankers and a final goods firm. Households work and consume both consumption goods and housing. Patient and impatient households are savers and borrowers, respectively. Financial intermediaries intermediate funds between consumers. Bankers are credit constrained in how much they can borrow from savers, and borrowers are credit constrained with respect to how much they can borrow from bankers. The representative firm converts household labor into the final good.

2.1 Savers

Savers maximize their utility function by choosing consumption, housing and labor hours:

$$\max E_0 \sum_{t=0}^{\infty} \beta_s^t \left[\log C_{s,t} + j \log H_{s,t} - \frac{(N_{s,t})^{\eta}}{\eta} \right],$$

where $\beta_s \in (0,1)$ is the patient discount factor, E_0 is the expectation operator and $C_{s,t}$, $H_{s,t}$ and $N_{s,t}$ represent consumption at time t, the housing stock and working hours, respectively. $1/(\eta-1)$ is the labor supply elasticity, $\eta > 0$. $j > 0$ constitutes the relative weight of housing in the utility function. Subject to the budget constraint:

$$C_{s,t} + D_t + q_t \left(H_{s,t} - H_{s,t-1}\right) = R_{s,t-1}D_{t-1} + W_{s,t}N_{s,t}, \tag{1}$$

where D_t denotes bank deposits, $R_{s,t}$ is the gross return from deposits, q_t is the price of housing in units of consumption, and $W_{s,t}$ is the wage rate. The first order conditions for this optimization problem are as follows:

$$\frac{1}{C_{s,t}} = \beta_s E_t \left(\frac{1}{C_{s,t+1}} R_{s,t} \right) \tag{2}$$

$$\frac{q_t}{C_{s,t}} = \frac{j}{H_{s,t}} + \beta_s E_t \left(\frac{q_{t+1}}{C_{s,t+1}} \right) \tag{3}$$

$$W_{s,t} = \left(N_{s,t}\right)^{\eta-1} C_{s,t} \tag{4}$$

Equation (2) is the Euler equation, the intertemporal condition for consumption, which implies that savers smooth consumption over time. Equation (3) represents the intertemporal condition for housing, in which, at the margin, benefits for consuming housing equate costs in terms of consumption. Equation (4) is the labor-supply condition.

2.2 Borrowers

Borrowers solve:

$$\max E_0 \sum_{t=0}^{\infty} \beta_b^t \left[\log C_{b,t} + j \log H_{b,t} - \frac{\left(N_{b,t}\right)^{\eta}}{\eta} \right],$$

where $\beta_b \in (0,1)$ is the impatient discount factor, subject to the budget constraint and the collateral constraint:

$$C_{b,t} + R_{b,t}B_{t-1} + q_t \left(H_{b,t} - H_{b,t-1}\right) = B_t + W_{b,t}N_{b,t}, \tag{5}$$

$$B_t \leq E_t \left(\frac{1}{R_{b,t+1}} k q_{t+1} H_{b,t} \right), \tag{6}$$

where B_t denotes bank loans and $R_{b,t}$ is the gross interest rate to be paid by borrowers for their loans. k can be interpreted as a loan-to-value ratio. The borrowing constraint limits borrowing to the present discounted value of their housing holdings, that is, they use housing as collateral. The first order conditions are as follows:

$$\frac{1}{C_{b,t}} = \beta_b E_t \left(\frac{1}{C_{b,t+1}} R_{b,t+1} \right) + \lambda_{b,t}, \tag{7}$$

$$\frac{j}{H_{b,t}} = E_t \left(\frac{1}{C_{b,t}} q_t - \beta_b E_t \left(\frac{q_{t+1}}{C_{b,t+1}} \right) \right) - \lambda_{b,t} \frac{1}{R_{b,t+1}} k q_{t+1}, \tag{8}$$

$$W_{b,t} = (N_{b,t})^{\eta-1} C_{b,t}, \tag{9}$$

where $\lambda_{b,t}$ denotes the multiplier on the borrowing constraint. These first order conditions can be interpreted analogously to the ones of savers with the difference that collateral terms appear in them reflecting wealth effects. Through simple algebra it can be shown that the Lagrange multiplier is positive in the steady state and thus the collateral constraint holds with equality. This means that borrowers, unlike savers, cannot smooth consumption because their consumption comes determined by how much they can borrow. This represents the first distortion of the model: borrowers do not have free access to financial markets and thus cannot freely smooth consumption.

2.3 Financial Intermediaries

Financial intermediaries solve the following problem:

$$\max E_0 \sum_{t=0}^{\infty} \beta_f^t \left[\log Div_{f,t} \right],$$

where $\beta_f \in (0,1)$ is the financial intermediary discount factor and $Div_{f,t}$ are dividends. Subject to the budget constraint and the collateral constraint:

$$Div_{f,t} + R_{s,t-1} D_{t-1} + B_t = D_t + R_{b,t} B_{t-1}, \tag{10}$$

where the right-hand side measures the sources of funds for the financial intermediary; household deposits and repayments from borrowers on previous loans. The funds can be used to pay back depositors and to extend new loans, or can be used as dividends. We assume here that dividends are transformed into consumption by banks, so that $Div_{f,t} = C_{f,t}$. As in Iacoviello (2014), we assume that the bank, by regulation, is constrained by the amount of assets minus liabilities, as a fraction of assets. That is, there is a capital requirement ratio. We define capital as assets minus liabilities, so that, the fraction of capital with respect to assets has to be larger than a certain ratio:

$$\frac{B_t - D_t}{B_t} \geq CRR. \tag{11}$$

Simple algebra shows that this relationship can be rewritten as:

$$D_t \leq (1 - CRR)\, B_t, \tag{12}$$

If we define $\gamma = (1 - CRR)$, we can reinterpret the capital requirement ratio condition as a standard collateral constraint, so that banks liabilities cannot exceed a fraction of its assets, which can be used as collateral:

$$D_t \leq \gamma B_t, \tag{13}$$

where $\gamma < 1$. The first order conditions for deposits and loans are as follows:

$$\frac{1}{C_{f,t}} = \beta_f E_t \left(\frac{1}{C_{f,t+1}} R_{s,t} \right) + \lambda_{f,t}, \tag{14}$$

$$\frac{1}{C_{f,t}} = \beta_f E_t \left(\frac{1}{C_{f,t+1}} R_{e,t+1} \right) + \gamma \lambda_{f,t}, \tag{15}$$

where $\lambda_{f,t}$ denotes the multiplier on the financial intermediary's borrowing constraint. Financial intermediaries have a discount factor $\beta_f < \beta_s$. This condition ensures that the collateral constraint of the intermediary holds with equality in the steady state, since $\lambda_f = \frac{\beta_s - \beta_f}{\beta_s}$>0. This binding constraint represents the second distortion of the model. The fact that financial intermediaries need to hold a certain amount of capital determines their dividends and therefore their consumption. Thus, like borrowers, they are not consumption smoothers.

2.4 Firms

Firms produce the final consumption good. The problem for the final good firms is standard and static. They maximize profits subject to the production function by using labor from both types of households:

$$\max \Pi_t = Y_t - W_{s,t}N_{s,t} - W_{b,t}N_{b,t},$$

$$Y_t = A_t N_{s,t}^{\alpha} N_{b,t}^{1-\alpha}, \tag{16}$$

where A_t represents a technology parameter. The problem delivers the standard first-order conditions, which represent the labor-demand equations:

$$W_{s,t} = \frac{\alpha Y_t}{N_{s,t}}, \tag{17}$$

$$W_{b,t} = \frac{(1-\alpha)\, Y_t}{N_{b,t}}. \tag{18}$$

2.5 Equilibrium

The total supply of housing is fixed and it is normalized to unity. The market clearing conditions are as follows:

$$Y_t = C_{s,t} + C_{b,t} + C_{f,t}, \tag{19}$$

$$H_{s,t} + H_{b,t} = 1. \tag{20}$$

3 Simulation

3.1 Parameter Values

The discount factor for savers, β_s, is set to 0.99 so that the annual interest rate is 4% in steady state. The discount factor for the borrowers is set to 0.98.[1] As in Iacoviello (2014), we set the discount factors for the bankers at 0.965 which, together with the bank leverage parameters implies a spread of about 1 percent (on an annualized basis) between lending and deposit rates. The steady-state weight of housing in the utility function, j, is set to 0.1 in order for the ratio of housing wealth to GDP to be approximately

[1] Lawrance (1991) estimated discount factors for poor consumers at between 0.95 and 0.98 at quarterly frequency. We take the most conservative value.

1.40 in the steady state, consistent with the US data. We set $\eta = 2$, implying a value of the labor supply elasticity of 1.[2] For the parameters controlling leverage, we set k and γ to 0.90, which implies a capital requirement ratio of 10%, in line with the US data.[3] The labor income share for savers is set to 0.64, following the estimate in Iacoviello (2005). We assume that technology, A_t, follows an autoregressive process with 0.9 persistence and a normally distributed shock. Table 1 presents a summary of the parameter values used:

Table 1: Parameter Values

β_s	.99	Discount Factor for Savers
β_b	.98	Discount Factor for Borrowers
β_f	.965	Discount Factor for Banks
j	.1	Weight of Housing in Utility Function
η	2	Parameter associated with labor elasticity
k	.90	Loan-to-value ratio
CRR	.10	Capital Requirement ratio
α	.64	Labor income share for Savers
ρ_A	.9	Technology persistence

3.2 Dynamics

3.2.1 Baseline Model

In this section, we simulate the impulse responses of the baseline model to illustrate its dynamics.

Figure 1 presents the impulse responses to a 1 percent shock to technology. Given the increase in technology, output increases and thus, consumption for the three agents increases. Borrowing increases and borrowers demand more housing, which is just partially compensated by a decrease in the housing by the savers. The increase housing demand, makes house prices go up. Therefore, since now housing collateral is worth more, consumption for borrowers increases further, given the collateral constraint they face. In this model, wealth effects are present through the collateral constraint. Situations in which house prices increase make the value of the collateral higher, and thus, wealth effects expand the economy even further.

[2] Microeconomic estimates usually suggest values in the range of 0 and 0.5 (for males). Domeij and Flodén (2006) show that in the presence of borrowing constraints this estimates could have a downward bias of 50%.

[3] See Iacoviello (2013).

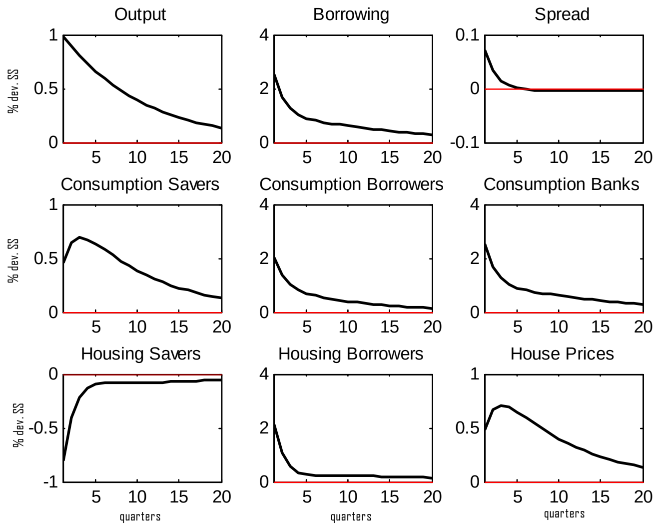

Figure 1: Impulse responses to a technology shock.

3.2.2 Different Capital Requirements

In order to understand the effect of the regulation on banks on the dynamics, here we simulate the model for different capital requirement ratios.

Figure 2 presents impulse responses to a technology shock for four different capital requirement ratios. We observe that, when the capital requirement ratio increases, borrowing decreases and therefore borrowers consume less. Banks, since they are not able to lend as much, also suffer a decrease in their consumption. However, the effect is the opposite for savers and this compensate the effect on borrowers and banks. Therefore, the overall effects are distributional and they do not affect the aggregate.

4 Welfare

4.1 Welfare Measure

To assess the normative implications of the different policies, we numerically evaluate the welfare derived in each case. As discussed in Benigno and Woodford (2008), the two approaches that have recently been used for welfare analysis in DSGE models include either characterizing the optimal Ramsey policy, or solving the model using a second-order approximation to the structural equations for given policy and then evaluating welfare using this solution. As in Mendicino and Pescatori (2007), we take this latter

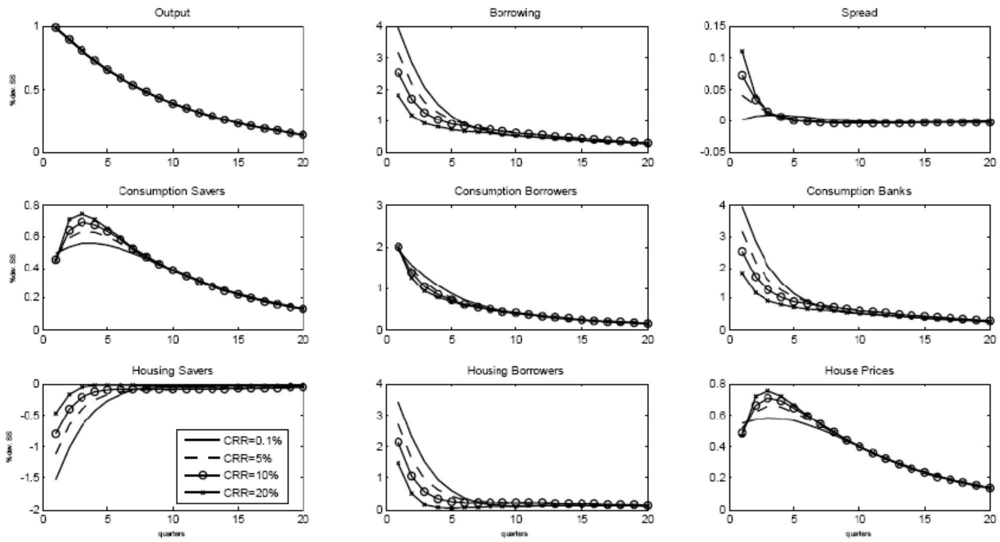

Figure 2: Impulse responses to a technology shock. Different capital requirement ratios.

approach to be able to evaluate the welfare of the three types of agents separately.[4] The individual welfare for savers, borrowers, and the financial intermediary, respectively, as follows:

$$W_{s,t} \equiv E_t \sum_{m=0}^{\infty} \beta_s^m \left[\log C_{s,t+m} + j \log H_{s,t+m} - \frac{(N_{s,t+m})^{\eta}}{\eta} \right], \tag{21}$$

$$W_{b,t} \equiv E_t \sum_{m=0}^{\infty} \beta_b^m \left[\log C_{b,t+m} + j \log H_{b,t+m} - \frac{(N_{b,t+m})^{\eta}}{\eta} \right], \tag{22}$$

$$W_{f,t} \equiv E_t \sum_{m=0}^{\infty} \beta_f^m \left[\log C_{f,t+m} \right]. \tag{23}$$

Following Mendicino and Pescatori (2007), we define social welfare as a weighted sum of the individual welfare for the different types of households:

$$W_t = (1 - \beta_s) W_{s,t} + (1 - \beta_b) W_{b,t} + (1 - \beta_f) W_{f,t}. \tag{24}$$

Each agent´s welfare is weighted by her discount factor, respectively, so that the all the groups receive the same level of utility from a constant consumption stream. We present results in consumption equivalent

[4] We used the software Dynare to obtain a solution for the equilibrium implied by a given policy by solving a second-order approximation to the constraints, then evaluating welfare under the policy using this approximate solution, as in Schmitt-Grohe and Uribe (2004). See Monacelli (2006) for an example of the Ramsey approach in a model with heterogeneous consumers.

units, as welfare gains with respect to a situation in which there is no capital requirement ratio.

4.2 Capital Requirement Ratios

Figure 3 presents the welfare change that each group experiments when increasing the capital requirement ratio for banks. Remember that there are two distortions in this economy, corresponding to the two collateral constraints, the one for the borrowers and the one for the financial intermediaries, respectively. Capital requirements affect directly the second distortion. Savers do not suffer from any of the distortion.[5] We see that there is a welfare trade-off between borrowers and savers. While savers are better off when banks are required to hold more capital, borrowers are worse off with this measure. The reason is that increasing capital requirements does not allow borrowers borrow as much as they would like and their consumption decreases. However, their borrowing constraint remains the same, and therefore their distortion is not being modified. Savers, who need to save to finance borrowing in equilibrium, can use part of their saving for consumption and therefore are better off. For banks, welfare starts to increase at an exponential level for larger values of the capital requirement ratio, starting at around 17%. When capital requirements are very large, banks cannot lend and they are able to transform all their assets into consumption. Remember that the discount factor of the financial intermediary is the lowest of the three agent. The fact that banks are extremely impatient makes their marginal propensity to consume the largest. This is the reason why welfare values increase so much after a certain threshold of the capital requirement ratio. For lower values of the capital requirement ratio, in the range of the Basel regulation, banks welfare slightly improves. Increasing the capital requirement ratio helps reducing the distortion implied by the collateral constraint of bankers. Given that they cannot smooth their consumption by themselves, higher capital requirements limit the loans they can make, stabilizing the financial system and therefore making their pattern of consumption also more stable. The lower left panel represents welfare of the households, disregarding banks. If we look at the welfare of the households, we see that increasing capital requirements is welfare increasing, that is, the welfare gain experimented by the savers compensates the loss of the borrowers. Total welfare mimics the pattern of banks, given that their gains are very large and dominate welfare of the other groups of the economy.[6]

[5] Note that in a model with sticky prices, this would be the distortion affecting savers. Prices are fully flexible in this setting.

[6] We eliminate banks from the welfare function in the "Households" panel to observe a cleaner pattern.

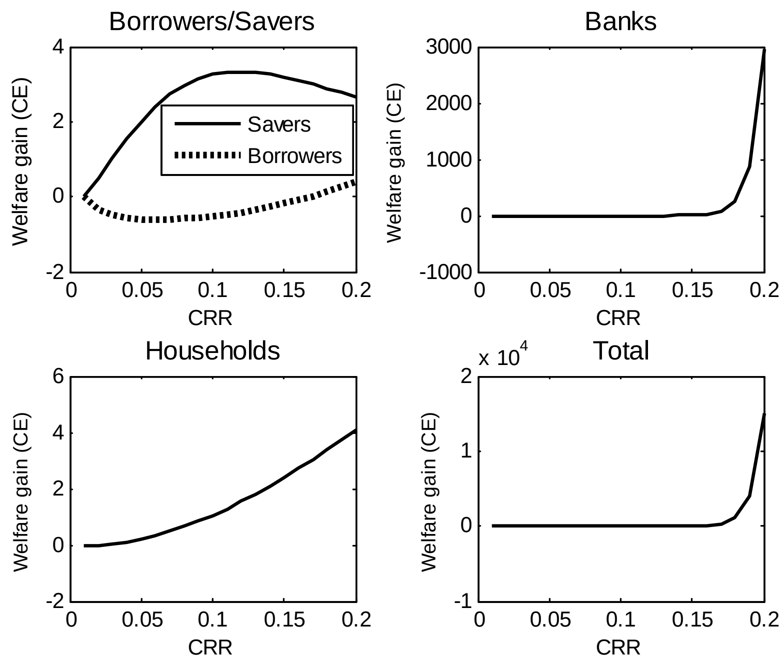

Figure 3: Welfare gains from increasing the capital requirement ratio.

5 Optimal Implementation of Basel III

Basel III states that there should be an extra discretionary countercyclical capital buffer that should avoid excessive credit growth (Basel III^{MP}).The purpose of this buffer is for the protection of the whole banking system from periods of excessive credit growth activities as it will work on preventing banks from following more than needed expansionary credit policies during economic booms that would increase the severity of inflation or more than needed contractionary ones during deflation that would deepen the economic downturn.

The size of the buffer is set by the regulator and must take account of the macroeconomic environment in which the bank operates. Therefore, it will applied accounting to national circumstances of countries' banks and related financial institutions.

However, the Basel III accord does not specify the criteria to change the capital requirement or under which specific conditions. There are however several things that we can infer from the Basel III statement:

-The countercyclical buffer is a macroprudential policy that uses the capital requirement ratio as an instrument

-The main objective of the Basel III^{MP} is to avoid excessive credit growth

-The regulator should use macroeconomic variables as indicators of excessive credit growth

Thus, along these lines, we propose a rule on the capital requirement ratio that includes credit growth, house prices and output in order to explicitly promote financial stability. In this way, Basel III^{MP} would be implemented as a simple rule, in the spirit of the Taylor rules used for monetary policy.[7]

$$CRR_t = (CRR_{SS}) \left(\frac{B_t}{B_{t-1}}\right)^{\phi_b} \left(\frac{Y_t}{Y}\right)^{\phi_y} \left(\frac{q_t}{q}\right)^{\phi_q} \tag{25}$$

This rule states that whenever regulators observe that credit is growing, or output and house prices are above their steady-state value, they automatically increase the capital requirement ratio to avoid an excess in credit. Then, this rule captures the macroprudential approach of Basel III^{MP} so that it anticipates credit growth and avoids it before hand, and it uses the capital requirement ratio as an instrument to achieve this goal. The goal is explicitly embedded in the rule since capital requirements respond directly to credit growth. The rule also includes other macroeconomic variables that can be seen as indicators of credit growth such as output and house price deviations from their respective steady states.

Then, we study what the optimal implementation of Basel III^{MP} would be, that is, the one that would maximize welfare:

5.1 Optimal Parameters

Table 2 presents the optimal parameters in equation (25) that maximize social welfare and compare results in terms of welfare gains with respect to the benchmark (no regulation).

We see that under Basel I and II (first column), only savers benefit from higher capital requirements, with respect to the no regulation situation. The third column presents the increase in capital requirements stated in Basel III, however, it does not take into account the countercyclical seasonal buffer. We see increasing the capital requirements as in Basel III makes everyone better off with respect to Basel I, II. Therefore, Basel III, without taking into account the countercyclical buffer, already represents a welfare improvement with respect to Basel I, II.

However, optimally implementing Basel III^{MP} manages to increase total welfare with respect to a situation of no regulation. Nevertheless, the losers in this case are the savers. Savers like increases in the static capital requirement ratio but they do not like the countercyclical buffer. However, the

[7] Note that the Taylor rule for monetary policy uses the interest rate as an instrument and it responds to output an inflation.

countercyclical buffer provides a more stable financial scenario. Both borrowers and banks benefit from this measure because it helps them both smooth their consumption and reduce the distortions that affect them.

In terms of the optimal implementation of the rule, we observe that the regulator should attach relatively more weight to the output and the house price parameters in the rule, rather than to the credit growth parameter. The reason for that is that these variables serve as an anticipated indicator of credit growth and therefore help the regulator achieve its macroprudential growth. When the regulator observes credit growth itself, it may be too late.

Table 2: Optimal Implementation of Basel III

	Basel I, II	**Basel III**	**Basel III^{MP}**
CRR_{SS}	8%	$8\% + 2.5\%$	$8\% + 2.5\%$
ϕ_b^*	-	-	0.1
ϕ_y^*	-	-	1.9
ϕ_q^*	-	-	1.6
Welfare gain			
Savers	2.97	3.29	-0.88
Borrowers	-0.58	-0.49	2.61
Banks	-0.99	-0.98	1.58
Total	-0.99	-0.96	4.61

5.2 Simulations

Here, we simulate the model for the Basel I and II requirements compared with Basel III^{MP}. Basel I and II require a total capital of 8%. In order to simulate Basel III^{MP}, we consider a capital requirement of 2.5%, that is, 10.5% in the steady state, together with the optimal macroprudential rule found in the previous section.

Figure 4 presents the model impulse responses to a technology shock for the two alternative scenarios: Basel I, II and Basel III^{MP}. We see that under Basel III^{MP}, following the technology shock, the capital requirement increases about 2% with respect to its steady state, while it remains at the steady state under Basel I, II. This higher capital requirement under Basel III makes that borrowing does not increase as much with the shock. Then, borrowers and banks can consume less under Basel III^{MP} but this is

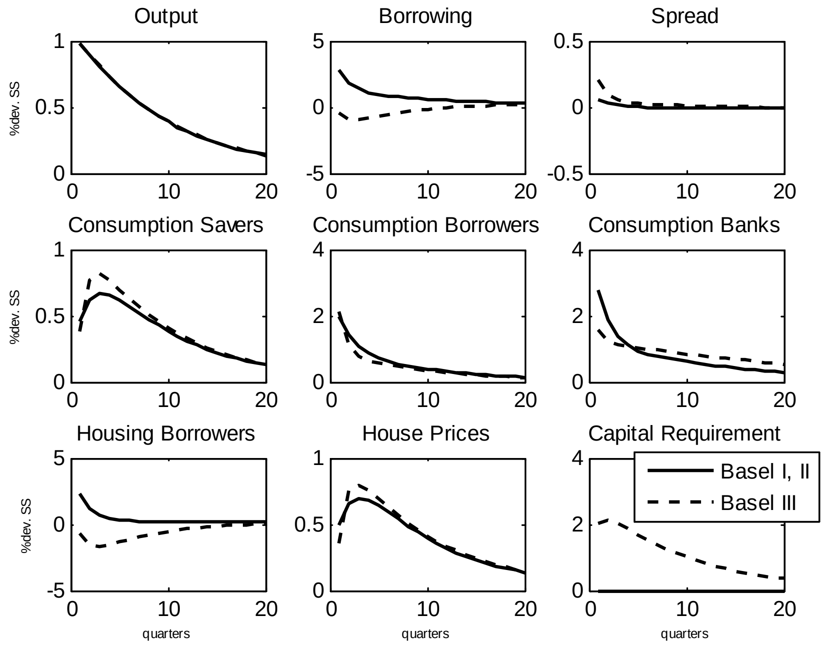

Figure 4: Impulse responses to a technology shock. Basel I, II versus Basel III^{MP}.

compensated by an increase in consumption by savers, which offsets aggregate differences. Therefore, we see that this measure is countercyclical for the agents that are directly affected by the capital requirement ratio, that is, borrowers and banks, while pro-cyclical for savers.

6 Concluding Remarks

In this paper, we take as a baseline a dynamic stochastic general equilibrium (DSGE) model, which features a housing market and a financial intermediary, in order to evaluate the welfare achieved by Basel I, II, and III regulations. Therefore, in the model, there are three types of agents: savers, borrowers and banks. Borrowers are constrained in the amount they can borrow. Banks are constrained in the amount they can lend, that is, there is a capital requirement ratio for banks.

First, we evaluate how the model responds to changes in the capital requirement ratio. We observe that higher capital requirements decrease the quantity of borrowing in the economy and as a consequence, both borrowers and banks can consume less. This is offset by higher consumption by savers. In terms of welfare, savers are better off if capital requirements increase, while borrowers are worse off. For banks, welfare increases a great deal after a capital requirement threshold because for very high capital requirements, they can consume all their assets.

Then, we compare Basel I and II with respect to Basel III in terms of dynamics and welfare. In order to do that, we propose a macroprudential rule for the capital buffer of Basel III (Basel III^{MP}). Following this rule, capital requirements would respond to credit growth, output and house prices. We find the optimal parameters of the rule that maximize welfare. Using the optimized parameters, we simulate the model and observe that, after a technology shock, capital requirements increase further in Basel III^{MP}, given the macroprudential measure. This extra increase in capital requirements cuts borrowing by more, achieving the goal of the regulation, which is to avoid excessive credit growth. We find that Basel III^{MP} is counter-cyclical for borrowers and banks, the agents directly affected by capital requirements, while pro-cyclical for savers. In terms of welfare, we see that the macroprudential component of Basel III^{MP} delivers higher welfare for the society than a situation with no regulation.

Appendix

Steady-State of the main model

$$C_s + D = R_s D + W_s N_s, \tag{26}$$

$$R_s = \frac{1}{\beta_s} \tag{27}$$

$$\frac{qH_s}{C_s} = \frac{j}{(1-\beta_s)} \tag{28}$$

$$W_s = (N_s)^{\eta-1} C_s \tag{29}$$

$$C_b = \frac{\beta_s - 1}{\beta_s} B + W_b N_b, \tag{30}$$

$$B = \beta_s k q H_b, \tag{31}$$

$$\lambda_b = (\beta_s - \beta_b), \tag{32}$$

$$\frac{1}{C_b}(q - (\beta_s - \beta_b)\beta_s k q - \beta_b q) = \frac{j}{H_b}, \tag{33}$$

$$W_b = (N_b)^{\eta-1} C_b, \tag{34}$$

$$C_f + B_t = \frac{\beta_s - 1}{\beta_s} D + R_b B, \tag{35}$$

$$\frac{D}{B} = \gamma, \tag{36}$$

$$\lambda_f = (\beta_s - \beta_f), \tag{37}$$

$$\frac{1 - \gamma(\beta_s - \beta_f)}{\beta_f} = R_b,$$

$$Y = A N_s^{\alpha} N_b^{1-\alpha}, \tag{38}$$

$$W_s = \alpha A \left(\frac{N_s}{N_b} \right)^{\alpha - 1}, \tag{39}$$

$$W_b = A \left(1 - \alpha\right) \left(\frac{N_s}{N_b} \right)^{\alpha}. \tag{40}$$

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