CFCM

CENTRE FOR FINANCE, CREDIT AND MACROECONOMICS

Working Paper 24/05

Macroprudential policy and credit spreads

Pauline Gandré and Margarita Rubio

Produced By:

Centre for Finance, Credit and Macroeconomics
School of Economics
Sir Clive Granger Building
University of Nottingham
University Park
Nottingham
NG7 2RD

www.nottingham.ac.uk/cfcm

Macroprudential Policy and Credit Spreads

Pauline Gandré*

University Paris Nanterre

Margarita Rubio†

University of Nottingham

October 2024

Abstract

Macroprudential policy is traditionally characterized by countercyclical rules responding to credit variables. In this paper, we augment macroprudential rules with additional indicators, including the credit spread. First, we empirically assess the validity of this extra variable by providing evidence on the correlation of a credit spread measure with credit booms. Then, we explicitly introduce this variable into a Dynamic Stochastic General Equilibrium (DSGE) model. We use our model to determine to which extent having countercyclical macroprudential measures also responding to credit spreads may be welfare improving, for both a capital requirement ratio (CRR) rule and a loan-to-value (LTV) rule. We find that the spread is a relevant indicator for credit-supply measures but not for borrower-based ones. For the latter, an additional response to house prices is more appropriate. We also find that the augmented rules deliver more financial stability, but at the expense of more inflation volatility, which reduces the welfare of the savers. Overall, the augmented rules improve welfare.

Keywords: Credit spreads, financial stability, macroprudential policy.

JEL Classification: E32, E44, E58.

---

*University Paris Nanterre & EconomiX, 200, av. de la République, 92000 Nanterre. e-mail: pgandre@parisnanterre.fr

†University of Nottingham, University Park, Sir Clive Granger Building, Nottingham. e-mail: margarita.rubio@nottingham.ac.uk

We thank conference participants at the 8th FMND workshop, the 13th FEBS conference and the 55th MMF conference for useful comments. Special thanks to Veronica Veleanu for her unvaluable help and insights.

1 Introduction

Since the 2008 Global Financial Crisis, there has been a focus on macroprudential and banking policies to create a sound financial system in which financial problems do not translate into the real economy. Various policies and instruments, with a flavor of countercyclicality, have been put in place to maintain financial stability. We can approximate these instruments as countercyclical rules that respond to credit and additional financial indicators. Examples of macroprudential instruments are capital requirement ratios (CRR) or borrower-based measures such as the loan-to-value ratio (LTV).

Authorities may emphasize any variables that make sense to them to assess the sustainability of credit growth and the level of system-wide risk. The Basel Committee on Banking Supervision published a Guidance Note in 2010 (Basel Committee on Banking Supervision (2010)) on how to operate the countercyclical capital buffer (CCyB). According to the Basel Committee, policies should be set such that the relevant authorities monitor credit growth and assess whether such growth is excessive and leads to the build-up of system-wide risk. The key issue here is which variables are to be used as indicators of excessive credit growth. The Basel Committee recommends using credit variables such as credit growth or the credit-to-GDP gap (i.e., the deviation of the credit-to-GDP ratio from its long-term trend). However, the Committee leaves some flexibility, stating that authorities are free to emphasize any other variables and qualitative information that make sense to them to assess the sustainability of credit growth and the level of systemic risk. The guidance proposes some examples of variables that may be useful indicators, such as various asset prices, funding spreads, and CDS spreads, credit condition surveys, real GDP growth, and data on the ability of non-financial entities to meet their debt obligations on a timely basis.

The literature has focused on augmenting countercyclical rules with asset prices or GDP, especially in those instances in which monetary policy is constrained and macroprudential policy needs to lend a helping hand in stabilizing the macroeconomy. However, the literature is silent on how the use of credit spreads as a macroprudential indicator can affect the optimality of rules and welfare. Then, along these lines, we propose countercyclical macroprudential rules that respond to credit spreads, analyze their optimality both for supply and borrower-based measures, and assess their implications for welfare and macro-financial stability.

To motivate the choice of credit spreads as a meaningful indicator for macroprudential countercyclical rules, first, we empirically test the validity of this variable by providing evidence on the correlation of a credit spread indicator with credit booms. Then, we explicitly introduce this variable into a Dynamic Stochastic General Equilibrium (DSGE) model. Our model features borrowers, savers, and financial intermediaries. Borrowers are constrained in the amount they can borrow, as they face a loan-to-value (LTV) ratio. Banks are constrained in the amount they can lend; that is, they have a capital requirement ratio (CRR). In the model, the credit spread represents the gap between the saver's interest rate on deposits (linked one-to-one with the policy rate) and the borrower's interest rate on borrowing.

We use our model to assess to which extent macroprudential measures responding to credit spreads may be welfare-improving. As a first experiment, we evaluate the welfare implications of introducing this variable in both a CRR and a LTV countercyclical rule. We find that credit spreads in the CRR increase welfare, while this is not the case for the LTV rule. We then compute the optimal parameters of a macroprudential rule, which includes both house prices and credit spreads, to maximize welfare. We compare our results with a benchmark rule that includes only credit growth as an indicator of the credit stance of the economy. Our results show the optimal weight the different rules should attach to each indicator so that we can give relevant policy recommendations in this respect. In particular, we find that the optimal weight on credit spreads is large and negative for the capital requirement ratio rule, but close to zero for the loan-to-value rule. This result suggests that the spread is a key variable for credit-supply side measures, but not for borrower-based ones. In the case of the latter, welfare is enhanced by responding to house prices.

We also find that the augmented rules deliver more stability to the economy. However, we see that stability comes at the expense of more volatility in inflation, which makes savers worse off. Savers, being the owners of intermediate goods firms, are more concerned about sticky prices; therefore, inflation volatility affects them more. Nevertheless, overall (for households and the whole economy), the augmented rule improves welfare.

The remainder of the paper is organized as follows. Section 2 describes the related literature. Section 3 provides empirical motivation for considering the credit spread variable as a relevant alternative variable for countercyclical macroprudential policy. Section 4 presents the model setup, while Section 5 shows the monetary and macroprudential policy rules. Section 6 presents the dynamics of the model. Section 7 describes our welfare measure and policy experiments. Section 8 concludes.

2 Related Literature

This paper is related to the literature that points out that credit spreads are a good indicator of the financial stance. However, most of the existing literature is focused on monetary policy. Several papers consider countercyclical policy responses to credit spreads to maintain financial stability from the point of view of monetary policy.

For instance, Taylor (2008) recommends that, in a Taylor rule, "one possible approach to adjusting the systemic component of monetary policy would be to subtract a smoothed version of [the] spread from the interest rate target that would otherwise be implied by developments with inflation and real growth GDP."

Similarly, from a theoretical point of view, Curdia and Woodford (2010) demonstrate that a standard monetary policy Taylor rule augmented with a negative adjustment for variations in credit spreads improves welfare. The optimal size of the reaction to credit spreads depends on the source of variation in credit spreads. Teranishi (2012) shows that a spread-adjusted Taylor rule is always optimal under heterogeneous loan contracts but that the sign of the response to the credit spread depends on the financial market structure. Caldara and Herbst (2019) empirically document that the US monetary policy rule reacted systematically to variations in corporate credit spreads during the Great Moderation. The effect is economically meaningful, with a ten basis-point increase in spreads leading to a ten basis-point decrease in the FED funds rate.

Our paper also relates to the literature that tries to establish the best way to implement macroprudential policy to obtain financial stability. Similarly to the literature mentioned above, Tayler and Zilberman (2016) study the economic implications of using credit spreads for the implementation of monetary policy. However, they find that a monetary policy reaction to credit spreads can be detrimental to welfare - as it is inflationary through the demand channel of monetary policy - and instead recommend implementing a Basel III-type countercyclical regulatory policy. Nevertheless, the macroprudential rule does not explicitly respond to credit spreads in their model, as it is in ours. In fact, unlike the monetary policy literature, the literature that considers credit spreads as a relevant variable for countercyclical macroprudential policy has remained scarce. Although the Basel Committee mentions credit spreads as a potential indicator for countercyclical buffer implementation (Basel Committee on Banking Supervision (2010)), the macroprudential literature has yet to explicitly introduce this variable in their modeling of macroprudential policy rules, especially for borrower-side measures.

Nevertheless, Levine and Lima (2015) study the optimal coordination between monetary policy and different macroprudential rules, including rules that respond to the credit spread, and Pozo (2023) investigate the impact of macroeconomic and financial stability of similar rules. However, unlike our paper, both articles focus on macroprudential instruments in the credit-supply sector (a tax on loans, a subsidy on the net worth of banks, or a CCyB rule). In contrast, we offer insights on the optimality of a response to credit spreads depending on the type of macroprudential instrument (borrower-based measures vs. credit-supply measures). We do so in a model with collateralized borrowing constraints that depend on the expected future value of housing assets. This feature enables us to investigate welfare effects resulting from interactions between the real sector, the housing sector, and the credit sector, as simultaneous housing and credit busts commonly characterize severe financial crises. We compare the advantages of using extra indicators (not just credit growth itself) for the optimal implementation of different macroprudential rules. For that, we propose credit spreads together with house prices to assess for which type of rules including these indicators may be welfare enhancing.

3 Empirical motivation

Among the most straightforward indicators of stress in the financial sector during the 2008 Global Financial Crisis and the Covid-19 crisis have been the unusual increases in (and volatility of) the spreads between the interest rates at which different classes of borrowers can fund their activities. Beginning in the run-up to the Global Financial Crisis, we find evidence that corporate credit spreads and household credit growth evolve in opposite directions in the US:[1]

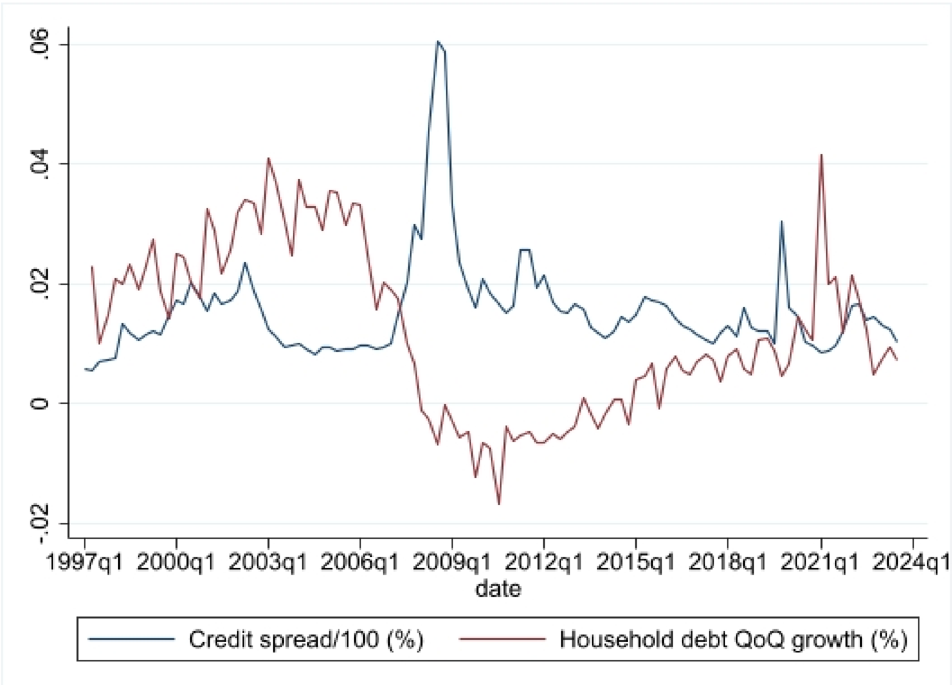

Figure 1: Joint evolution of credit spread and credit growth

We find statistically significant negative correlations between corporate credit spread and a set of variables usually monitored to evaluate credit conditions in the US over 1997 Q1-2023 Q3 (Table 1). The P-values are shown in brackets.

We also find a significant negative correlation between corporate credit spreads and real GDP quarter-on-quarter growth, showing that credit spreads are countercyclical. Thus, as we approach a recession, mortgage and household debt fall dramatically (due to a drop in credit availability, higher delinquencies, etc.), and house price growth declines, whereas credit spreads rise. The increase in the credit spread thus captures higher default risk and higher risk premia. In contrast, lower credit spreads are associated with credit booms and expansions.

[1]For the corporate credit spread variable, we use the standard ICE BofA US Corporate Index Option-Adjusted Spreads, which is the spread between a computed Option-Adjusted Spread index of all bonds considered investment grade (rated BBB or above) and a spot Treasury curve. The index is constructed using the spread of each constituent bond, weighted by market capitalization. For the growth rate of household debt, we calculated the quarterly growth rate of total liabilities of households and nonprofit organizations from the Flow of Funds of US National Accounts.

Correlations with corporate credit spread (%)	
Total household debt QoQ growth (%)	-0.48 (0.0000)
Mortgage household debt QoQ growth (%)	-0.39 (0.0000)
House price QoQ growth (%)	-0.49 (0.0000)
Real GDP QoQ growth (%)	-0.35 (0.0002)

Table 1: Correlations between credit spread and other credit and macroeconomic variables

Credit spreads appear as a good alternative candidate to credit and house price growth variables when conducting countercyclical macroprudential policies. In fact, in addition to being a good indicator of credit booms and busts, credit spreads present specific characteristics relative to other measures of credit condition. They are a price variable instead of a quantity variable, reflecting risk perceptions, and they are more countercyclical in times of elevated stress, as documented by Akinci and Queralto (2022), allowing one to design different macroprudential policy responses depending on the cycle. Moreover, credit spreads are available in real time, differently from quantity variables.

In addition, focusing on credit spreads makes it possible to disentangle between demand and supply conditions in credit markets, because credit spreads are a measure of excessive credit supply. Thus, as emphasized in Giese et al. (2014), "before a crisis, we would expect spreads to be low if risk premia were unsustainably compressed due to exuberant credit supply (e.g. before the current crisis), whereas they may be at normal levels if credit growth reflected a greater balance between demand and supply factors (e.g. before the secondary banking crisis and the small banks' crisis)". Moreover, since monetary policy rules responding to credit spreads can be associated with higher inflation (Levine and Lima (2015), Tayler and Zilberman (2016)), focusing on the macroprudential response to credit spreads appears as an empirically relevant alternative.

Therefore, in our paper, we evaluate whether a countercyclical macroprudential policy also responding to credit spreads improves welfare, depending on the type of macroprudential instrument.

4 Model Setup

The modeling framework is a DSGE model with banks and a housing market, following Iacoviello (2015). The economy features patient and impatient households, bankers, and final-goods and intermediate-goods firms. Households work and consume both consumption goods and housing. Patient and impatient households are savers and borrowers, respectively. Financial intermediaries intermediate funds across 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. The central bank follows a standard Taylor rule for setting interest rates.

4.1 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, with $\eta > 0$. $j > 0$ constitutes the relative housing weight in the utility function. Savers are subject to the following budget constraint:

$$C_{s,t} + d_t + q_t (H_{s,t} - H_{s,t-1}) = \frac{R_{s,t-1} d_{t-1}}{\pi_t} + w_{s,t} N_{s,t} + \Pi_t,$$

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, $w_{s,t}$ is the real wage rate, and Π_t is the aggregate profit of intermediate-goods firms that are owned by savers. The first-order conditions for this optimization problem are as follows:

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

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

$$w_{s,t} = (N_{s,t})^{\eta-1} C_{s,t}. \tag{3}$$

Equation (1) is the Euler equation, i.e., the intertemporal condition for consumption. Equation (2) represents the intertemporal condition for housing, in which, at the margin, benefits from buying housing assets equate costs in terms of consumption. Equation (3) is the labor-supply condition.

4.2 Borrowers

Borrowers solve:

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

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

$$C_{b,t} + \frac{R_{b,t} b_{t-1}}{\pi_t} + q_t (H_{b,t} - H_{b,t-1}) = b_t + w_{b,t} N_{b,t},$$

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

where b_t denotes bank loans and $R_{b,t}$ is the gross interest rate. k can be interpreted as a loan-to-value ratio. The borrowing constraint limits borrowing to a fraction of the present discounted value of housing holdings. The first-order conditions are as follows:

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

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

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

where $\lambda_{b,t}$ denotes the multiplier on the borrowing constraint.[2] These first-order conditions can be interpreted analogously to the ones of savers.

[2]Through simple algebra, one can show that the Lagrange multiplier is positive in the steady state, and thus, the collateral constraint holds with equality.

4.3 Financial Intermediaries

Financial intermediaries solve the following problem:

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

where $\beta_f \in (0,1)$ is the financial intermediary discount factor, subject to the budget constraint:

$$C_{f,t} + \frac{R_{s,t-1} d_{t-1}}{\pi_t} + b_t = d_t + \frac{R_{b,t} b_{t-1}}{\pi_t},$$

where the right-hand side measures the sources of funds for the financial intermediary, i.e., household deposits and repayments from borrowers on previous loans. These funds can be used to pay back depositors and to extend new loans, or can be used for consumption. As in Iacoviello (2015), we assume that the bank, by regulation, is constrained by the amount of assets less liabilities, that is, the bank faces a capital requirement ratio. We define capital as assets minus liabilities, so that the fraction of capital relative to assets has to be larger than a certain ratio:

$$\frac{b_t - d_t}{b_t} \geq CRR.$$

Simple algebra shows that this relationship can be rewritten as:

$$d_t \leq (1 - CRR)\, b_t.$$

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:

$$d_t \leq \gamma b_t,$$

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

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

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

where $\lambda_{f,t}$ denotes the multiplier on the financial intermediary's borrowing constraint.[3] The spread is defined as the difference between the loan rate and the deposit rate.[4]

4.4 Final-Good Producers

A continuum of identical final-good producers operates under perfect competition and flexible prices. They aggregate intermediate goods according to the following production function:

$$Y_t = \left[\int_0^1 Y_t\left(z\right)^{\frac{\varepsilon-1}{\varepsilon}} dz \right]^{\frac{\varepsilon}{\varepsilon-1}},$$

where $\varepsilon > 1$ is the elasticity of substitution between intermediate goods. The final-good firm chooses $Y_t(z)$ to minimize its costs, resulting in the following demand of intermediate good z:

$$Y_t\left(z\right) = \left(\frac{P_t(z)}{P_t} \right)^{-\varepsilon} Y_t.$$

The price index is then given by:

$$P_t = \left[\int_0^1 P_t\left(z\right)^{1-\varepsilon} dz \right]^{\frac{1}{\varepsilon-1}}.$$

4.5 Intermediate-Good Producers

The intermediate-good market is monopolistically competitive. Intermediate goods are produced according to the following production function, as in Iacoviello (2015):

$$Y_t\left(z\right) = A_t N_{s,t}\left(z\right)^{\alpha} N_{b,t}\left(z\right)^{(1-\alpha)},$$

[3] 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 $\lambda_f = \frac{\beta_s - \beta_f}{\beta_s} > 0$.

[4] Note that in the model, we specify a loan-deposit spread whereas, as an illustration, we showed a corporate bond spread in the previous empirical section, due to data availability.

where $\alpha \in [0,1]$ measures the relative size of each group in terms of labor.[5] This Cobb-Douglas production function implies that the labor efforts of constrained and unconstrained consumers are not perfect substitutes. This specification is analytically tractable and allows for closed-form solutions for the steady state of the model. This assumption can be economically justified by the fact that savers are the managers of the firms and their wage is higher than that of the borrowers.[6] A_t represents technology, and it follows the following autoregressive process:

$$\log(A_t) = \rho_A \log(A_{t-1}) + u_{At},$$

where ρ_A is the autoregressive coefficient and u_{At} is a normally distributed shock to technology. We normalize the steady-state value of technology to 1.

Labor demand is determined by:

$$w_{s,t} = \frac{1}{X_t} \alpha \frac{Y_t}{N_{s,t}}$$

and

$$w_{b,t} = \frac{1}{X_t} (1-\alpha) \frac{Y_t}{N_{b,t}},$$

where X_t is the markup or the inverse of the marginal cost.[7] The price-setting problem for the intermediate good producers is a standard Calvo-Yun setting. An intermediate good producer sells its good at a price $P_t(z)$ and $1-\theta \in [0,1]$ is the probability of being able to change the sale price in every period. The optimal reset price $P_t^*(z)$ solves:

$$\sum_{k=0}^{\infty} (\theta\beta_s)^k E_t \left\{ \Lambda_{t,k} \left[\frac{P_t^*(z)}{P_{t+k}} - \frac{\varepsilon/(\varepsilon-1)}{X_{t+k}} \right] Y_{t+k}^*(z) \right\} = 0, \tag{4}$$

where $\varepsilon/(\varepsilon-1)$ is the steady-state markup and $\Lambda_{t,k}$ is the stochastic discount factor. The aggregate price level is then given by:

$$P_t = \left[\theta P_{t-1}^{1-\varepsilon} + (1-\theta)(P_t^*)^{1-\varepsilon} \right]^{1/(1-\varepsilon)}. \tag{5}$$

[5] Notice that the absolute size of each group is one.

[6] It could also be interpreted as the savers being older than the borrowers, therefore more experienced.

[7] Symmetry across firms allows us to write the demands without the index z.

Using (4) and (5) and log-linearizing, we can obtain a standard forward-looking New Keynesian Phillips curve $\widehat{\pi}_t = \beta_s E_t \widehat{\pi}_{t+1} - \psi \widehat{x}_t$, that relates inflation positively to future inflation and negatively to the markup ($\psi \equiv (1-\theta)(1-\beta_s\theta)/\theta$).[8]

4.6 Equilibrium

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

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

and

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

5 Modelling Monetary and Macroprudential Policies

In the standard New Keynesian model, the central bank aims at minimizing output and inflation variability to reduce the distortion introduced by nominal rigidities and monopolistic competition. However, in models with collateral constraints, welfare analysis and the design of optimal policies involve several issues not considered in standard sticky-price models. There are two types of distortions in models with constrained individuals: price rigidities and credit frictions. This feature creates conflicts and trade-offs between borrowers, savers, and banks.

Savers may prefer policies that reduce the price stickiness distortion. However, borrowers may prefer a scenario in which the pervasive effect of the collateral constraint is softened. Borrowers operate in a second-best situation. They consume according to the borrowing constraint, as opposed to savers who follow an Euler equation for consumption. Borrowers cannot smooth consumption by themselves, but a more stable financial system would provide them with a setting in which their consumption pattern is smoother. In turn, banks may prefer policies that ease their capital constraint since capital requirement ratios distort their ability to smooth consumption.

[8] Variables with a hat denote percent deviations from the steady state.

5.1 Monetary Policy

For monetary policy, we consider a Taylor rule, which responds to inflation and output growth:

$$R_t = (R_{t-1})^{\rho} \left(\pi_t^{\left(1+\phi_{\pi}^{R}\right)} \left(Y_t/Y_{t-1}\right)^{\phi_y^R} R \right)^{1-\rho},$$

where $0 \leq \rho \leq 1$ is the parameter associated with interest rate inertia, and $\phi_{\pi}^{R} \geq 0$ and $\phi_y^R \geq 0$ measure the response of interest rates to current inflation and output growth, respectively.

5.2 Countercyclical Macroprudential Rules

Following the Basel III guidelines, we use rules that respond to credit growth as a benchmark macroprudential rule (both for CRR and the LTV ratio). These rules are analogous to the rule for monetary policy, but they use the CRR and the LTV ratio as instruments:

$$CRR_t = CRR_{SS} \left(\frac{b_t}{b_{t-1}} \right)^{\phi_b}.$$

This rule states that whenever the regulator observes that credit is growing, it automatically increases the CRR to avoid an excess in credit.

In the same way, we propose a macroprudential rule that takes the LTV ratio as an instrument:

$$LTV_t = LTV_{SS} \left(\frac{b_t}{b_{t-1}} \right)^{-\phi_b}.$$

In this case, the rule states that when the regulator observes credit growth, the LTV decreases. We then propose an augmented Taylor-type rule that includes not only credit growth but also house prices and the spread to explicitly promote stability and reduce systemic risk.

$$CRR_t = CRR_{SS} \left(\frac{b_t}{b_{t-1}} \right)^{\phi_b} \left(\frac{q_t}{q_{t-1}} \right)^{\phi_q} \left(\frac{sp_t}{sp_{t-1}} \right)^{-\phi_{sp}}.$$

This rule imposes that whenever the regulator observes that credit is growing, house prices are increasing, or the credit spread narrows, the CRR will increase.

Similarly, we propose the following augmented macroprudential rule with the LTV as an instrument:

$$LTV_t = (LTV_{SS}) \left(\frac{b_t}{b_{t-1}}\right)^{-\phi_b} \left(\frac{q_t}{q_{t-1}}\right)^{-\phi_q} \left(\frac{sp_t}{sp_{t-1}}\right)^{\phi_{sp}}.$$

In this case, the LTV will decrease if the regulator observes a credit boom coming from any of the three indicators.

6 Simulations

6.1 Parameter values

The discount factor for savers, β_s, is set to 0.99, so the annual interest rate is 4% in the steady state. The discount factor for borrowers is set to 0.98.[9] As in Iacoviello (2015), we set the discount factors for the bankers at 0.965, which, for a bank leverage parameter of 10%, 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 for the ratio of housing wealth to GDP to be approximately 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.[10] For the parameters controlling leverage, we set k in line with Iacoviello (2005) and Iacoviello (2015) for US data. γ is the parameter governing the CRR, which we set according to the Basel III regulation (10.5%). The labor income share for savers α is set to 0.64, following the estimate in Iacoviello (2005). We assume that technology, A_t, follows an autoregressive process with 0.90 persistence and a normally distributed shock.[11] In the following simulations and experiments, we use an illustrative standard deviation of the TFP shock of 1%. Table 2 summarizes the parameter values used.

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

[10] 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 estimate could have a downward bias of 50%.

[11] The persistence of the shock is consistent with the estimates in Iacoviello and Neri (2010).

Parameter Values		
β_s	0.99	Discount Factor for Savers
β_b	0.98	Discount Factor for Borrowers
β_f	0.965	Discount Factor for Banks
j	0.1	Weight of Housing in Utility Function
η	2	Parameter associated with labor elasticity
k	0.90	Loan-to-value ratio
α	0.64	Labor income share for Savers
θ	0.75	Calvo probability of fixed price
γ	10.5%	Capital requirement ratio
ρ_A	0.9	Technology persistence
ρ	0.8	Interest rate smoothing
ϕ_π	0.5	Reaction to inflation in the monetary policy rule
ϕ_y	0.5	Reaction to output in the monetary policy rule

Table 2: Summary of Parameter Values

6.2 Dynamics

In this section, using the model and the parameter values described above, we show the dynamics generated by the model. To have a meaningful model before moving to the policy experiments, we compute impulse responses of the main macro and financial variables that are relevant to the analysis.

Figure 2 displays the impulse responses to a technology shock. We pick this shock as a paradigmatic example of a supply-side shock, which is standard in the RBC and New Keynesian literature. This illustration intends to show that our model behaves sensibly following a well-known shock. As expected, output increases, and inflation decreases in response to the shock. Technology shocks make production more efficient, which is why the economy can produce more at a lower price. In terms of housing and financial variables, we see that the increase in house prices and the decrease in interest rates generate a collateral effect for borrowers. Thus, both credit and investment in mortgaged houses increase. In terms of spread, it decreases. Thus, house prices and credit go up, whereas credit spreads go down. Therefore, the model predicts a negative comovement between spreads and credit/housing variables, as in the data.

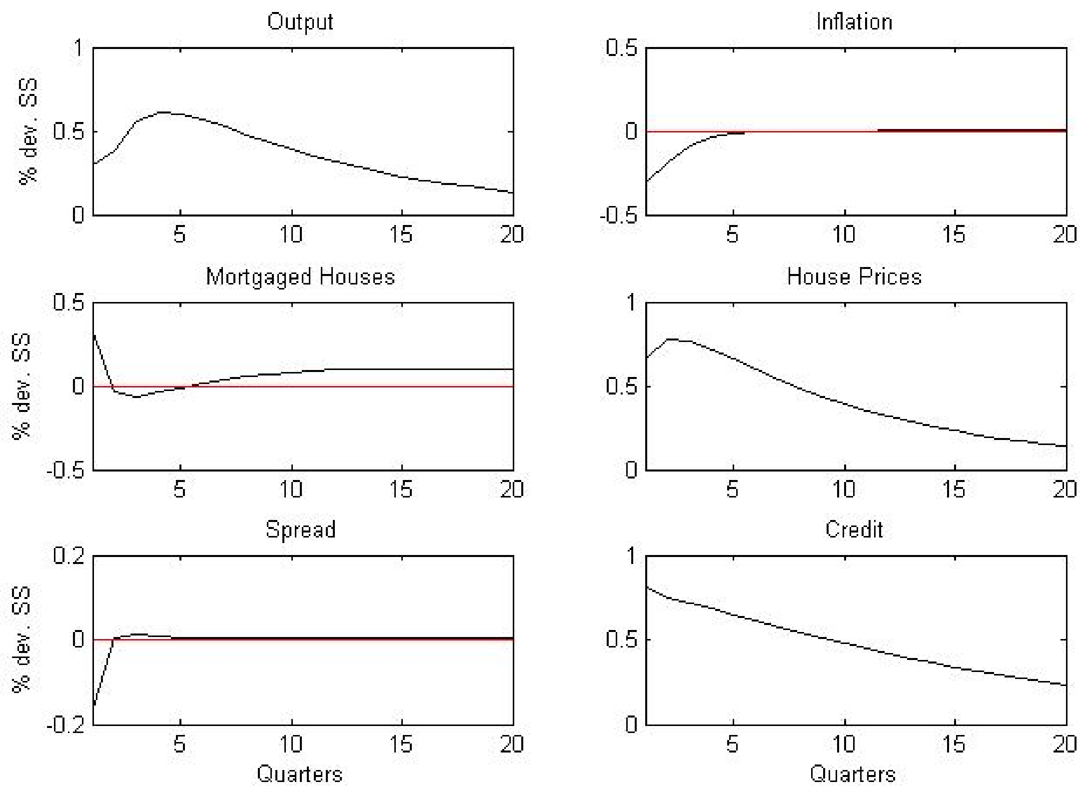

Figure 2: Impulse response functions

Given that the model generates impulse responses that are in line with empirical evidence, we proceed with the policy experiments in the next section.

7 Optimal Policy

7.1 Welfare Measure

To assess the normative implications of the different policies, we numerically evaluate household welfare in each case. As discussed in Benigno and Woodford (2012), the two approaches that have been used for welfare analysis in DSGE models include characterizing the optimal Ramsey policy or solving the model using a second-order approximation to the structural equations for a given policy and then evaluating welfare using this solution. Following, for example, Rubio (2020), we take this latter approach to be able to evaluate the welfare of the three types of agents separately[12] The individual welfare for savers, borrowers, and the financial intermediary, respectively, writes as follows:

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

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

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

We aggregate welfare as a weighted sum of the individual welfare for the different types of households. Each agent's welfare is weighted by her discount factor, respectively, so that all the groups receive the same level of utility from a constant consumption stream. Then, we can define household welfare as:

$$W_{h,t} = (1 - \beta_s) W_{s,t} + (1 - \beta_b) W_{b,t},$$

and total welfare as:

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

7.2 Policy experiments

We now present the policy experiments related to our research question. We intend to show that macroprudential rules augmented with credit spreads are welfare improving. We also introduce house prices in the augmented rule to include an extra demand-side measure.

First, to gain some intuition, as an illustration, we calculate the welfare gains associated with including only credit spreads (in addition to credit) in the CCR and the LTV rule.[13] This indicator is a non-standard measure of the credit stance of the economy, which implies that we need to under-

[12] 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-Grohé and Uribe (2004). See Monacelli (2008) for an example of the Ramsey approach in a model with heterogeneous consumers.

[13] Note that in this first experiment, to isolate the effect of including credit spreads in the rules, we do not include house prices.

stand first what the implications of introducing this measure for welfare are.

In Figure 3, taking as a benchmark macroprudential rules that respond only to credit, as the Basel III committee prescribes, we introduce credit spreads in the rule to check if augmenting the rule is welfare-improving. We do this separately for the LTV and the CRR rule by shutting down the CRR rule when looking at the LTV rule and conversely. We set the Taylor rule parameter on credit equal to 0.5 as an arbitrary benchmark for this first illustrative experiment.

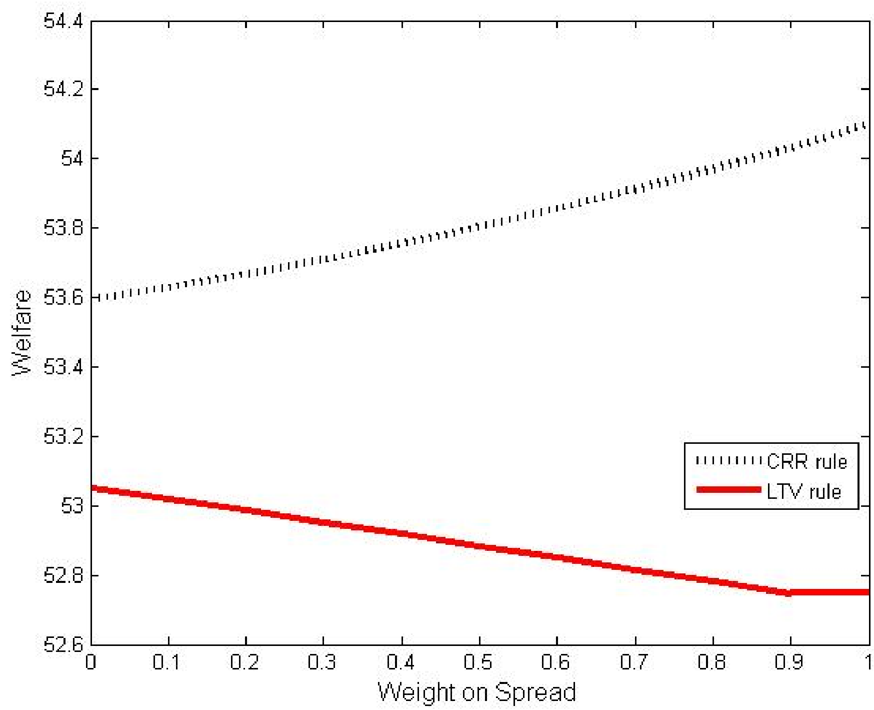

Figure 3: CRR and LTV rules. Welfare value for different weights on the spread.

We find that a CRR rule responding to credit spreads and credit performs better than a rule responding only to credit. However, an LTV rule responding to credit spreads and credit performs worse than a rule responding only to credit. These first results seem to indicate that credit spreads, because they are a supply-side indicator, are useful for supply-side measures but not for borrower-based or demand-side ones like the LTV. For the LTV, it may be the case that an extra demand-side indicator, such as house prices, works better. Therefore, in our following optimized parameter exercises, following this intuition, we also include house prices when augmenting the macroprudential rules.

Table 3 presents our main policy experiments; that is the optimized parameters for the CRR and the LTV ratio macroprudential rules. We take a macroprudential countercyclical rule which responds only to credit as a benchmark, both for the LTV and the CRR. This type of rule would correspond to a standard benchmark rule prescribed by the Basel Committee. Then, we augment the rule to include our proposed new indicator, credit spreads. However, in light of the results found above, we also augment the rule with house prices. We search for the parameters that maximize welfare in both the CRR and LTV ratio rules. We run the experiment separately for each rule, shutting down the alternative rule.

Optimized Parameters	Benchmark Rule	Augmented Rule
ϕ_b^{CRR}	0.15	0.02
ϕ_{sp}^{CRR}	-	-1.92
ϕ_q^{CRR}	-	0.001
ϕ_b^{LTV}	-1.75	-0.57
ϕ_{sp}^{LTV}	-	0.001
ϕ_q^{LTV}	-	-0.21

Table 3: Optimized macroprudential rules

When we only look at the benchmark rule, the one only responding to credit, we find that it is optimal for the LTV rule to respond more strongly to credit than the CRR rule. The LTV rule needs to be more active than the CRR to maximize welfare. We then augment both rules with the above-mentioned extra variables. In line with our previous exercise, we find that if we augment the rule, the optimal CRR rule responds very strongly to the spread. Credit spreads seem to be an excellent indicator for countercyclical CRR rules. However, in line with our intuition, responding to the spread is not welfare enhancing in the case of the LTV ratio. On the contrary, responding to house prices increases welfare. Thus, the spread appears to be important for credit-supply macroprudential measures but not for borrower-based ones. House prices are the variable that matters for the latter.

In light of these results, we can conclude that rules that respond only to credit may give a partial picture of the credit conditions of the economy. Augmenting the rules with other credit-related variables increases welfare. Nevertheless, regulators should be careful with the extra indicators that they are using: depending on whether the macroprudential measure is demand or supply-side related, the relevant indicator might differ. As an example, we have found that credit spreads are a good indicator for CRR rules but not such for LTV rules. House prices are more relevant for the latter case.

To understand the source of the welfare gains in the optimized augmented rules, we compute the consumption equivalent gain for all the agents of the model. We also include the aggregate household welfare gain and the total welfare.

In Table 4, we see that using the augmented rules benefits the economy. The only group that does not see a gain is the savers; the rest of the agents find a welfare-improving situation. This makes sense because borrowers and banks are directly affected by collateral constraints. Because borrowers are affected by the LTV ratio constraint, having a welfare-improving rule that includes house prices benefits them. As banks are affected by the CRR constraint, a rule that includes the credit spread is beneficial for them. As for the savers, they care about the sticky-price distortion but not about the collateral distortion.

Optimized Augmented Rule	**Welfare Gain**
Borrowers	0.082
Savers	-0.044
Households	0.034
Banks	0.803
Total	0.866

Table 4: Welfare gains (Consumption Equivalents)

Table 5 shows the optimized augmented rules' effects on macroeconomic and financial stability. This table reports the standard deviations of inflation, output, credit, and house prices. The first two standard deviations, i.e., inflation and output, correspond to macroeconomic stability. The last two, i.e., credit and house prices, relate to financial stability. This analysis helps understand where the welfare gains found in Table 4 come from.

Macro-Fin Stability	Optimized Benchmark	Optimized Augmented
σ_π	0.3244	0.3328
σ_y	1.8026	1.7922
σ_b	0.4919	0.4827
σ_q	2.0118	2.0074

Table 5: Volatility of macro-financial variables

We see that financial stability comes at the expense of more volatility in inflation, which is what makes savers worse off. Savers, being the owners of the intermediate-good firms, are concerned by sticky prices. Therefore, inflation volatility affects them more. This increase in inflation volatility explains why savers are worse off with the augmented rules. However, financial stability is positively affected by including the new indicators in the macroprudential rules. Credit spreads in the CRR rule, and house prices in the LTV ratio rule, reduce the volatility of credit and house prices. This is welfare-enhancing for borrowers and banks. Overall, for households and the total economy, the optimized augmented rules increase welfare.

8 Concluding Remarks

In this paper, we explore the use of credit spreads as an indicator for macroprudential policy. The Basel Committee advocates for countercyclical macroprudential rules that respond to credit variables (i.e., credit-to-GDP, credit growth, etc.) and leaves it open to include other indicators in the rules, such as funding spreads and asset prices. In our analysis, we first empirically analyze the relationship between credit spreads and the financial side of the economy. This empirical fact motivates the use of the credit spread as a good indicator of the financial stance.

Then, we build a DSGE model that generates impulse responses in which the correlation between credit spreads, credit quantity, and the housing market observed in the data is present. Our DSGE model includes a countercyclical macroprudential rule for the CRR, as an example of a credit-supply macroprudential policy measure, and a countercyclical rule for the LTV ratio, representing a demand-side macroprudential measure.

Because our proposal is novel in the literature, to get some intuition, we analyze the effects on welfare of including credit spreads in both rules as a first step. We find that introducing credit spreads in macroprudential rules is welfare-improving for CRR rules but not for LTV rules. This result suggests that the spread is a key variable in credit-supply side measures, but house prices, as suggested by the Basel Committee, would work better for demand-side measures.

With this intuition in mind, we then calculate the optimized parameter values for a rule for the CRR and the LTV ratio, which responds to credit, house prices, and the spread. We find that for the benchmark case (a standard rule just responding to credit), it is optimal for the LTV rule to react more strongly to credit than the CRR rule. However, if we augment the rule, the CRR rule responds very strongly to the spread. In the case of the LTV, responding to the spread is not important; reacting to house prices matters more. The spread seems relevant for credit-supply measures but not borrower-based ones, and house prices are more relevant for the latter.

We also find that the augmented rules deliver more financial stability to the economy, which is why borrowers and banks who are affected by collateral constraints, see welfare gains. However, financial stability comes at the expense of higher volatility in inflation, which makes savers worse off. Savers, being the owners of intermediate-goods firms, are more concerned about sticky prices; therefore, inflation volatility affects them more. In any case, for households as a whole and the total economy, augmenting the rules to include extra variables such as house prices and the credit spread is welfare-improving.

References

Akinci, O. and Queralto, A. (2022). Credit spreads, financial crises, and macroprudential policy. *American Economic Journal: Macroeconomics*, 14(2):469–507.

Basel Committee on Banking Supervision (2010). Guidance for national authorities operating the countercyclical capital buffer. Technical report.

Benigno, P. and Woodford, M. (2012). Linear-quadratic approximation of optimal policy problems. *Journal of Economic Theory*, 147(1):1–42.

Caldara, D. and Herbst, E. (2019). Monetary policy, real activity, and credit spreads: Evidence from bayesian proxy svars. *American Economic Journal: Macroeconomics*, 11(1):157–92.

Curdia, V. and Woodford, M. (2010). Credit spreads and monetary policy. *Journal of Money, Credit and Banking*, 42(s1):3–35.

Domeij, D. and Flodén, M. (2006). The labor-supply elasticity and borrowing constraints: Why estimates are biased. *Review of Economic Dynamics*, 9(2):242–262.

Giese, J., Andersen, H., Bush, O., Castro, C., Farag, M., and Kapadia, S. (2014). The Credit To GDP Gap And Complementary Indicators For Macroprudential Policy: Evidence From The UK. *International Journal of Finance & Economics*, 19(1):25–47.

Iacoviello, M. (2005). House prices, borrowing constraints, and monetary policy in the business cycle. *American Economic Review*, 95(3).

Iacoviello, M. (2015). Financial business cycles. *Review of Economic Dynamics*, 18(1):140–163.

Iacoviello, M. and Neri, S. (2010). Housing market spillovers: Evidence from an estimated DSGE model. *American Economic Journal: Macroeconomics*, 2(2):125–64.

Lawrance, E. C. (1991). Poverty and the rate of time preference: Evidence from panel data. *Journal of Political Economy*, 99(1):54–77.

Levine, P. and Lima, D. (2015). Policy mandates for macro-prudential and monetary policies in a new keynesian framework. Working Paper Series 1784, European Central Bank.

Monacelli, T. (2008). Optimal Monetary Policy with Collateralized Household Debt and Borrowing Constraints. In *Asset Prices and Monetary Policy*. University of Chicago Press.

Pozo, J. (2023). The effects of countercyclical leverage buffers on macroeconomic and financial stability. *The Quarterly Review of Economics and Finance*, 89:194–217.

Rubio, M. (2020). Cross-country spillovers from macroprudential regulation: Reciprocity and leakage. *Journal of International Money and Finance*, 103:102134.

Schmitt-Grohé, S. and Uribe, M. (2004). Solving dynamic general equilibrium models using a second-order approximation to the policy function. *Journal of Economic Dynamics and Control*, 28(4):755–775.

Tayler, W. J. and Zilberman, R. (2016). Macroprudential regulation, credit spreads and the role of monetary policy. *Journal of Financial Stability*, 26:144–158.

Taylor (2008). Monetary policy and the state of the economy. In: Testimony before the committee on financial services US house of representatives. February 26th, 2008.

Teranishi, Y. (2012). Credit spread and monetary policy. *Economics Letters*, 114(1):26–28.