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**Monetary and macroprudential policy adopted in a model with house price booms**

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This dissertation is submitted in partial fulfilment of the requirements for the

**Master of Commerce degree in Economics.**

Supervisor: Dr Simiso Msomi

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**DECLARATION**

I **Arehone Praise Matambele** declare that

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As the candidate's supervisors, I agree to the submission of this dissertation for examination. Based on the Turnitin report and to the best of our knowledge, the dissertation is primarily the student's work, and he has acknowledged all the sources he has used.

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# Abstract

The coordination of monetary and macroprudential policies in stabilising housing market shocks continues to be a critical unresolved debate. This leaves Africa's high-debt emerging markets vulnerable to systemic risks and housing wealth volatility. There is a growing body of literature exploring new policy instruments that could be more effective in achieving financial stability. This need for efficiency and the correct macroprudential instrument underpins this study, which focuses on testing the joint use of two macroprudential instruments alongside monetary policy. To address this gap, the study employs a DSGE model calibrated for South Africa's literature. Furthermore, the study assumes a closed economy and thereby assesses the effectiveness of monetary policy and the macroprudential tools (LTV and CCyB) during house price booms. Findings suggest that coordination reduces house price volatility, where LTV is more effective in stabilising domestic credit and countercyclical buffers addressing external shocks; however, South Africa's housing market differences result in uneven effectiveness across income groups.



**Keywords**: Monetary policy, macroprudential, DSGE model, housing prices
**JEL Classification Numbers**: E44, E52, E58

# Table of Contents

## List of Tables



## List of Figures

# Chapter One

## 1. Introduction

The coordination of monetary and macroprudential policies to manage systemic risks in housing market booms remains an unresolved debate in economic policy (Laeven et al., 2022; Muellbauer, 2024). This debate is particularly relevant for high-debt emerging markets, such as those in Africa, which are more vulnerable to systemic risk, market price volatility and financial instability (Elkhishin & Mohieldin, 2021). The 2007-2008 global financial crisis highlighted the limitations of traditional policy frameworks, which primarily targeted inflation and output growth, leaving the financial system exposed to systemic shocks (Rathnayaka et al., 2024). This led researchers to have a renewed search for effective macroprudential instruments that can be implemented to safeguard the financial system (Claessens, 2015).

Previous research indicates that macroprudential instruments, such as loan-to-value (LTV) limits and countercyclical capital buffers (CCyB), can help stabilise credit markets (Epaulard, 2022; Behncke, 2023). However, there is little guidance on how these tools should be integrated with monetary policy to manage housing-driven financial cycles. This uncertainty poses a practical challenge for policymakers, who may struggle to determine an optimal policy mix. This has the potential to result in either excessive credit growth or unnecessary constraints on economic expansion. The financial accelerator framework, suggests that uncoordinated policies can intensify credit booms and asset price fluctuations, heightening financial instability (Oliviero & Puopolo, 2021). In the absence of evidence on the effects of coordinated policy, reliance on individual instruments or conventional monetary rules leaves economies vulnerable to avoidable systemic risks.

At the heart of the policy dilemma is the dual role of housing in the economy. On one hand, housing is a basic consumption good (Li, 2023). On the other, it serves as a key asset, often representing the largest share of household wealth (Goodhart & Hofmann, 2006). This dual function, coupled with housing's use as collateral for loans, creates a strong link between property values, household

debt, and broader financial stability (Ryan-Collins, 2021). In the economic theory, the financial accelerator mechanism shows how an increase in house prices leads to increased collateral value, and this can reduce credit constraints and lead to more borrowing and investment (Iacoviello, 2005). However, this often sets off a self-reinforcing cycle, credit expands and asset prices rise during booms, only to unravel sharply during downturns (Oliviero & Puopolo, 2021). Key factors behind these cycles include loose credit conditions, such as high loan-to-value (LTV) ratios, and optimistic expectations of future price gains, both of which can fuel feedback loops that inflate bubbles (Duca et al., 2010; Duca et al., 2021).

Policymakers have developed several macroprudential tools in response to this. These include borrower-based measures, such as loan-to-value (LTV) limits, which aim to curb excessive household leverage by targeting credit demand. On the supply side, institution-based tools like countercyclical capital buffers (CCyB) require banks to build up capital reserves during periods of economic expansion, thereby strengthening their resilience and helping to moderate credit growth (Andrae, 2024). Evidence suggests these tools can be effective, but their success is highly contingent on design and context (Claessens et al., 2013). The debate continues on whether monetary policy should "lean against the wind," meaning it should tighten to slow rising asset prices and prevent financial problems (Schularick et al., 2021). Critics argue that such an approach risks potential policy errors (Kockerols & Kok, 2021) while supporters highlight the dangers of neglecting financial stability concerns (Cecchetti, 2000). This lack of consensus creates uncertainty, underscoring the need for empirical analysis of policy coordination.

House price booms pose a risk to economic stability, which calls for policymakers to strike a balance between monetary and macroprudential policy (Duca et al., 2021). Historically, central banks have prioritised inflation targeting and economic growth, often overlooking the systemic risks posed by asset price fluctuations (Kiley & Mishkin, 2024). Focusing this study on the house price booms in South Africa is particularly important because similar drivers could also increase the risk of economic volatility. Therefore, it is important to know the dynamics to safeguard the financial stability. In South Africa, major cities experience faster house price increases since this is where there is a growing demand for houses and the increase in one city can diffuse to other cities (Balcilar, 2013). For high-debt countries like South Africa, with a high debt-to-income ratio,

these factors highlight that the housing market can be unstable, making it an important sector to focus on within this study (Chikeya & Ntsalaze, 2025).

The South African housing market experienced a housing bubble during the early 2000s, and fluctuations were significant within different market segments (Das et al., 2011). Evidence shows 2 that in South Africa, the house price fluctuations mostly affect all housing market segments except for the affordable segments (dwellings with prices below R430 000) and luxury segments (priced between R3.1 million to R11.5 million) (Das et al., 2011). A large proportion of the affordable houses are provided by the government, while luxury properties are mostly owned by high-income earners who are less affected by economic fluctuations (Bhanye et al., 2024).

During the 1990s to 2007s, South Africa had an average of 17 per cent increase in mortgage loans per annum (Maphosa, 2020). Property financing becomes a crucial subject, especially given that housing accounts for a large portion of household wealth, meaning that swings in this market could lead to inflation and affect the financial stability of the economy (Das et al., 2009).

During the COVID-19 pandemic, the South African Reserve Bank (SARB) cut the repo rate from 6.5% to 3.75%, making borrowing cheaper and increasing credit accessibility, which helped lower mortgage defaults (South African Reserve Bank, 2020). However, implementing the policies as separate entities could result in conflicting outcomes, as demonstrated by the SARB's interest rate hikes in 2022, which contributed to a further rise in household debt (Claessens et al., 2013). This supports the theory that a decrease in collateral value diminishes asset worth, creating feedback loops that exacerbate recessions, particularly evident in the South African context within this period (Iacoviello, 2005).

Despite the systemic risks involved, there is still a limited amount of research on how monetary and macroprudential policies can work together in developing countries, especially in Africa (Nyati et al., 2023). South Africa, with its data availability and observed credit cycles, serves as an ideal case study for exploring this coordination. Additionally, findings show that incorporating monetary policy rules during an ongoing economic boom can help mitigate the boom cycle and reduce debt accumulation (Maphosa, 2020).

Previous research on South Africa, an ideal case study due to its data availability and observed credit cycles, has examined monetary policy alongside instruments like LTV and CCyB in isolation (Dlamini & Ngalawa, 2022; Liu & Molise, 2020; Nyati et al., 2023). These studies found that such tools can contain credit growth and reduce housing market volatility. Furthermore, South Africa's housing market is deeply heterogeneous; its affordable and luxury segments are less affected by economic fluctuations than the middle-income segment, suggesting that policy effectiveness may be uneven across income groups (Das et al., 2011). This highlights the importance of assessing not just financial stability outcomes but also the welfare implications for different agents.

This study directly addresses these gaps. Its primary objective is to examine the impact of coordinating monetary policy with a composite macroprudential index, combining the LTV ratio and the CCyB, on the South African economy's response to housing price shocks. A secondary objective is to assess whether this policy coordination generates welfare gains compared to using each instrument in isolation. To achieve this, the paper employs a Dynamic Stochastic General Equilibrium (DSGE) model calibrated for a closed South African economy.

This modelling strategy is particularly appropriate for studying housing market shocks and policy interactions. This is because DSGE models are grounded in microeconomic foundations (Christiano et al., 2005). They allow for the explicit modelling of heterogeneous agents (savers, borrowers, and entrepreneurs) and the financial frictions that link housing collateral to credit conditions (Iacoviello, 2005). The framework captures forward-looking behaviour and expectations, which are central to both monetary policy transmission and housing market dynamics (Smets & Wouters, 2007). Additionally, DSGE models enable systematic counterfactual policy analysis. This allows for the comparison of alternative regimes under controlled conditions, which is essential for evaluating the coordination questions at the heart of this study (Kannan et al., 2009; Liu & Molise, 2020).

The model builds on the work of Iacoviello (2005) and Kannan et al. (2009) and features heterogeneous agents (patient savers, impatient borrowers, entrepreneurs, and banks), a financial

accelerator mechanism, and a banking sector subject to capital requirements. The key innovation of this model is its treatment of macroprudential policy. Unlike prior studies that often introduce LTV shocks exogenously, this research incorporates both the LTV (a demand-side tool) and the CCyB (a supply-side tool) as active policy instruments within a single composite index. This allows for a novel analysis of their coordinated use.

The analysis considers three distinct policy regimes: a baseline with a standard Taylor rule and no active macroprudential policy (Regime I); a regime combining the standard Taylor rule with the composite macroprudential index (Regime II); and a regime featuring an augmented Taylor rule (reacting to credit growth) coordinated with the composite macroprudential index (Regime III).

The results from this provide new theoretical and policy insights into the coordination debate. They demonstrate that when monetary policy is jointly implemented with the composite macroprudential index, the economy becomes significantly more resilient to housing market shocks. Specifically, loan-to-value caps are shown to stabilise domestic credit, while countercyclical capital buffers shield the banking system from external shocks. Crucially, these findings contribute to the ongoing theoretical discussion on whether monetary policy should "lean against the wind" of asset prices. By showing that coordinated frameworks can reduce welfare losses without compromising long-term growth, the study provides a reconciliatory perspective that monetary policy can remain focused on inflation, provided macroprudential instruments are actively coordinated. This bridges the gap between opposing schools of thought in the post-crisis literature.

## 1.1. Research problem

The coordination of monetary and macroprudential policies remains one of the most contested and unresolved issues in policy design (Dlamini & Ngalawa, 2022). A central controversy continues over whether monetary policy should react to asset prices at all. While some argue that monetary policy should focus solely on inflation and output, others claim that ignoring asset prices reinforces financial imbalances and amplifies crises (Cecchetti, 2001; Liu & Molise, 2020). The absence of

consensus matters because ignoring asset-price dynamics has been shown to intensify financial imbalances and heighten the severity of crises (Kannan, 2009). This conflicting guidance leaves policymakers without a clear framework when facing credit booms or house price surges which brings some uncertainty on the appropriate division of responsibilities between monetary and macroprudential authorities during booms. It leaves economies vulnerable precisely when coordinated responses are most needed

The urgency of this problem is amplified in modern financial systems, where evidence shows that monetary policy alone is insufficient to contain systemic risk. The 2007-2008 global financial crisis showed that inflation targeting could not prevent credit booms. It revealed that existing policies were insufficient to safeguard stability and led researchers to explore new policy instruments that could be more effective (Paoli & Paustian, 2017; Rubio & Carrasco-Gallego, 2014). This part of the literature highlights that macroprudential tools can complement monetary policy in mitigating house price booms, however, the critical question of how they should be coordinated remains unanswered.

Previous South African studies on macroprudential policy have primarily examined individual tools such as loan-to-value (LTV) caps and countercyclical capital buffers (CCyB), showing that each can reduce credit growth and dampen housing market volatility when applied independently (Dlamini & Ngalawa, 2022; Liu & Molise, 2020; Nyati et al., 2023). However, testing these tools "in isolation" overlooks the fact that housing and credit markets in South Africa are characterised by strong two-way feedback effects where borrower leverage affects bank balance sheets, while bank lending constraints influence household consumption and investment. The effectiveness of the policies depends on how they were designed and implementation strategies (Claessens et al., 2013). From the macroprudential tools, the loan-to-value caps capture the demand side of the loans by restricting household leverage, the countercyclical buffers influence bank lending capacity.

Macroprudential policies protect the banking system and the overall economy from systemic risks. These risks can be cyclical, when institutions take excessive risks in good times and become overly cautious in downturns, leading to booms and busts or cross-sectional, when problems at one institution spill over to the broader system (Dlamini & Ngalawa, 2022). Both arise from market

failures, but each of these may require different policy tools (Schoenmaker & Wierts, 2011). While the literature emphasises the importance of instrument choice, there remains a critical gap in understanding how multiple macroprudential instruments can be coordinated and evaluated jointly, especially in emerging markets like South Africa. This study aims to address this gap by employing a Dynamic Stochastic General Equilibrium (DSGE) model, calibrated to South Africa's closed economy. This study therefore examines the joint effectiveness of monetary policy and a composite macroprudential index combining LTV and CCyB tools, with the aim of understanding both stabilisation outcomes and welfare implications which gives practical guidance for policymakers.

## 1.2. Contribution and Significance

This study makes a substantial contribution to the macroeconomic policy literature by offering a model-based analysis of policy coordination in the case of a high-debt emerging market. The main innovation is in the implementation of a composite macroprudential policy index that integrates both a demand-side instrument (Loan-to-Value ratio) and a supply-side instrument (Countercyclical Capital Buffer). This approach advances the current literature, which often assesses these tools in isolation, by providing a more comprehensive framework for policy analysis.

Previous studies, such as Dlamini & Ngalawa (2022), focus on the effectiveness of loan-to-value (LTV) ratios in controlling credit demand, while Liu & Molise (2020) examine the impact of countercyclical capital buffers (CCyB) on bank lending capacity (credit supply). However, these studies look at only one macroprudential tool in isolation. In contrast, this paper combines both LTV ratios and CCyB, allowing it to capture both the demand and supply side of credit to provide a more comprehensive approach to financial stability.

The significance of this research is twofold. First, it demonstrates that coordinated use of monetary and macroprudential policies can enhance financial stability and reduce output volatility, particularly in response to housing demand shocks, a common source of macro-financial instability in emerging markets. Second, it highlights the conditional effectiveness of such coordination, as

beneficial under specific shock scenarios, such as credit booms; however, the same policies may lead to suboptimal outcomes if applied during productivity-driven expansions. This study provides policymakers in South Africa and similar economies with insights for designing a balanced and responsive policy mix.

## 1.3. Research Questions

- How does the coordination of monetary policy and macroprudential policy influence the economy's response to housing price shocks in South Africa?
- Does the coordination of these two policies generate welfare gains compared to using each policy instrument in isolation?

## 1.4. Research Hypotheses

Based on the theoretical framework and the gaps identified in the literature, this study tests the following hypotheses:

- $H_1$: Coordinating monetary policy with a composite macroprudential index (combining LTV and CCyB) dampens housing price volatility and credit growth compared to monetary policy alone.
- $H_2$: Full policy coordination, where monetary policy responds directly to financial conditions (Regime III), yields greater welfare gains for credit-constrained households than basic coordination (Regime II).

## 1.5. Research Objectives

- Examine the impact of coordinated monetary and macroprudential policies on housing price shocks in the South African economy.
- Assess whether policy coordination leads to improvements in household and aggregate welfare.

The remainder of the study is organised as follows. Chapter 2 reviews the literature on housing market dynamics, monetary policy, macroprudential tools, and policy coordination, concluding with a summary of how the literature informs the model specification. Chapter 3 presents the DSGE model, detailing the behaviour of households, firms, banks, and the policy authorities, as well as the construction of the composite macroprudential index. Chapter 4 presents the impulse response analysis for housing demand, technology, LTV, and CCyB shocks across the three policy regimes. It further reports the welfare analysis and discusses the policy implications of the findings. Chapter 5 concludes the study, summarising the main results, acknowledging limitations, and offering directions for future research.

# Chapter Two

## 2. Literature Review

This chapter reviews the theoretical and empirical literature that forms the foundation for this study's investigation into the coordination of monetary and macroprudential policy in South Africa. The review begins by examining the dynamics of housing markets, focusing on the role of housing as collateral and the drivers of house price cycles. It then traces the evolution of macroeconomic thought, from models that overlooked financial frictions to the development of the financial accelerator theory, which explains how credit markets can amplify economic fluctuations. Building on this, the chapter discusses the objectives and tools of monetary policy in the context of asset prices, before turning to the rationale and instruments of macroprudential policy. A key focus is the ongoing debate on the need for coordination between these two policy arms and the trade-offs involved. The review concludes by identifying a specific gap in the literature concerning the combined use of demand-side and supply-side macroprudential tools in South Africa, which this study aims to address using a Dynamic Stochastic General Equilibrium (DSGE) framework.

## 2.1. Housing Market Dynamics and the Financial Accelerator

House prices reflect expected future returns, such as rental income, while also serving as a living space from which households derive utility (Goodhart & Hofmann, 2006, p. 5). Housing is a significant component of household wealth and is often used as collateral during purchases (Zevelev, 2021). Price fluctuations in the housing market can destabilise the economy and reduce its responsiveness to adjustments compared to other assets (Stundziene et al., 2023). These prices adjust slowly due to construction lags, transaction costs and other market frictions (Duca et al., 2021). Such fluctuations can affect household consumption through wealth effects. House values show households' borrowing capacity, as houses used as collateral link real estate values to the household debt and financial stability (Kakuru & Kaulihowa, 2022).

The house price cycle is mainly driven by changes in factors such as population growth, income growth, interest rate and housing supply conditions (Duca et al., 2021). Credit availability through tools such as higher loan-to-value (LTV) and debt-service-to-income ratios also drives house price booms by expanding the pool of borrowers (Duca et al., 2010). Expectations of future house prices are also key drivers, as buyers often assume that past growth will continue (Kuchler et al., 2023). This assumption can create a "bubble-builder" feedback loop that can reverse during downturns (Anundsen, 2019). Lenders (savers) tend to prefer periods with high interest rates, as they provide more room for savings and higher returns (Lambertini., 2011).

On the other hand, borrowers prefer periods with low interest rates since it is cheaper for them to borrow (Barboni & Agarwal, 2023). These contrasting preferences lead to differing expectations about the future and can further lead to price conflicts, resulting in rapid price increases and booms (Lambertini., 2011). Additionally, house price cycles differ across regions due to differences in housing supply elasticity, with more inelastic areas experiencing larger price swings (Glaeser et al., 2008).

The failure of pre-crisis models to capture these dynamics stemmed from a more fundamental omission. Most models developed before the Global Financial Crisis (GFC) overlooked the linkages between credit markets, housing, and the broader economy (Duca et al., 2021). The financial accelerator mechanism initially introduced by Bernanke et al. (1996) explains how credit tightening can amplify booms or busts. Following the GFC, additional drivers of house price booms were identified, including household credit constraints and large house price declines, both of which have been shown to have a strong influence on economic fluctuations (Gertler & Gilchrist, 2018; Mian & Sufi, 2018).

Financial accelerator theory explains how falling asset prices reduce borrowers' collateral value, leading banks to restrict lending and amplify recessions (Mishkin, 2007). This mechanism arises from credit market frictions where borrowers and savers have asymmetric information, creating a cycle in which falling asset values reduce investment (Konstantakopoulou, 2023). Christensen and Dib (2008) find that while financial accelerators amplify housing price shocks and explain investment swings, their effect on GDP is relatively small. These findings contrast with earlier

models that ignored financial frictions, pointing to the need for macroprudential tools to reduce financial accelerator feedback loops (Christiano et al., 2005; Cerutti et al., 2015).

Although traditional economic theory, particularly the financial accelerator framework, posits that minimal credit requirements amplify volatility (Bernanke et al., 1996). Evidence shows that when banks reduce credit requirements, such as lowering down payment requirements, it increases procyclicality of credit and asset prices since households' borrowing capacity has increased and this leads to boom-bust cycles (Iacoviello & Pavan, 2013). Supporting these findings, an analysis of Dutch housing rules indicates that this stabilising effect is more pronounced in lower-income households when both income uncertainty and rising house prices have been accounted for (Caloia, 2024).

The housing collateral amplifies broader economic fluctuations by restricting borrowing capacity and tightening the cycles. This was shown in a DSGE model with heterogeneous households of patient savers and impatient borrowers (Iacoviello, 2005). It aligns with the financial accelerator theory, where rising house prices lower borrowing costs and increase investment, and further inflate prices, creating a self-reinforcing cycle (Bernanke et al., 1996). In South Africa, after the 2008 crisis, higher interest rates and stricter credit conditions decreased access to mortgage finance and led to a slower house-price growth (Hollander & Havemann, 2021). The effects are more pronounced on low-income borrowers who are sensitive to credit conditions (Gupta & Kabundi, 2010).

## 2.2. Monetary Policy and Asset Price Cycles

Monetary policy mainly aims to stabilise inflation and output by adjusting interest rates (Nyati et al., 2023). Its scope has expanded to include housing markets where financial stability concerns arise due to price risks. Housing is a vital part of household wealth, which often requires substantial financing, causing households to depend on bank loans secured by housing collateral (Zevelev, 2021). Rising house prices increase collateral value, making borrowing cheaper for households and boosting credit demand, which further drives prices up (Duca et al., 2021). When applying policy within a New Keynesian framework, traditional rules may be ineffective in reducing

economic fluctuations, thus necessitating enhanced monetary rules that incorporate tools such as nominal credit growth, which are more effective (Kannan et al., 2009).

Subsequent research examined policies to manage economic cycles, finding that a monetary policy reacting to credit growth, such as an augmented Taylor rule, reduced GDP volatility during housing booms compared to inflation-focused rules (Dlamini & Ngalawa, 2022). However, the findings warn that during productivity-driven booms, rigid rules can harm the economy if lending becomes excessively restricted (Kannan et al., 2009). Introducing new shocks, such as expectations, showed that modifying LTV rules to limit borrowing relative to house values during a boom decreases debt-to-GDP volatility without worsening inflation, compared to interest rate rules (Lambertini et al., 2011). This aligns with Iacoviello's (2005) findings on the role of housing collateral in economic cycles. These studies emphasise the importance of identifying shock types before implementing policies to avoid exacerbating economic fluctuations.

Scholars revisited whether central banks need to target asset prices, such as housing, or should continue focusing on inflation and output (Liu & Molise, 2020). Within this discussion, some authors oppose central banks reacting directly to asset prices (Bernanke & Gertler, 2001; Svensson, 2018). This contradicts those who advocate that central banks should incorporate financial stability rules, namely macroprudential tools, within their monetary policy frameworks (Cecchetti, 2000; Nair & Anand, 2020). While these arguments differ, they emphasise that policymakers must exercise caution to avoid misidentifying shocks, which could lead to errors where financial risks are amplified (Svensson, 2016).

## 2.3. Macroprudential Policy Tools and Effectiveness

Macroprudential policy involves regulatory measures aimed at safeguarding financial stability by limiting systemic risks (Claessens et al., 2013). This includes tools such as loan-to-value (LTV) ratios, debt-to-income (DTI) limits and countercyclical capital buffers (Borio, 2003; Claessens et al., 2013). For example, when these policies are adjusted to respond to credit growth by tightening credit requirements in periods of high credit expansion, policymakers can better manage risks

(Kannan et al., 2009). Although such measures are crucial for preventing credit booms, evidence suggests they are most effective when coordinated with monetary policy, particularly interest rate adjustments (Borio & Zhu, 2012).

Conversely, financial stability tools like LTV rules help to reduce risky borrowing without suppressing the broader economy since they restrict how much households can borrow against their homes (Borio, 2003). Macroprudential policies are mostly useful in strengthening banking systems and reducing systemic risk to ensure financial stability (Albertazzi et al., 2021). It is argued that emerging economies are often more exposed to international financial shock spillovers compared to advanced economies (Hallam, 2022). Therefore, policymakers must consider the country-specific characteristics and the effectiveness of other risk-mitigating tools when designing policies. Systemic risks can be cyclical, arising when financial institutions take excessive risks in good times and become overly cautious in downturns, or cross-sectional, when problems at one institution spread across the system (Magubane, 2025). Both types usually arise from market failures and therefore require different policy responses (Schoenmaker & Wierts, 2011).

Cross-country data show that the effects of busts and booms are more pronounced on emerging countries than advanced countries (Farboodi & Kondor, 2022). In these emerging markets, macroprudential policies are used more frequently due to their higher financial volatility (Claessens et al., 2013). When the shocks are coming from external countries, the countercyclical capital buffers in domestic countries were helpful in reducing the spillover effects from their credit and housing markets (Borio & Zhu, 2012; Bussière et al., 2021).

However, for informal credit markets, this does not appear to be the case, as these financial stability tools fail due to the higher asymmetric information, and dishonest lenders who can take advantage of price hikes, and in this case, the financial accelerator effect becomes more pronounced (Panda, 2023). Given cross-border risks, small economies may need to account for cross-country effects when designing macroprudential policies.

The effectiveness of macroprudential policies during economic distress can also depend on the origin of the shock, as this might stem from either local or external country shocks (Bussière et al.,

2021). Emerging countries are often more exposed to shocks occurring in advanced nations, especially those investing in their domestic economies (Rey, 2015). When a shock originates from domestic issues, the central bank typically responds by lowering policy rates to support spending and economic activity (Mishkin, 2010). This aligns with earlier research showing that limits on borrowing linked to home values can make good times better and bad times worse, because changes in house prices affect how much people can borrow (Iacoviello, 2005).

Emerging countries have placed more emphasis on macroprudential policies and have used these tools more often than developed countries (Cerutti et al., 2015). Before the global financial crisis, evidence shows that they were used four times more than in developed countries and their use continued even after the crisis (Claessens, 2015). Their higher usage can be attributed to emerging economies' high exposure to external financial shocks, their need to protect their currency and their less developed financial systems (Dlamini & Ngalawa, 2022). From this, the most used tools are LTV caps, followed by DTI. These are also mainly used by developed countries when they want to limit borrowing during shocks, while developing countries mostly use them to target currency risk and liquidity (Vandenbussche et al., 2015). LTV and DTI are shown to be effective in reducing house price booms and risky borrowing; however, overall, the macroprudential tools have been more effective in preventing financial instability than in resolving shocks once they occur (Dell'Ariccia et al., 2012; Obeid & Fund, 2022).

Macroprudential tools were originally designed for use by banks but are now applied to the entire financial system. On the demand side, they affect borrowers who seek loans from banks (LTV), while some focus on the supply side, where they restrict the availability of credit from banks (CCyB) (Claessens, 2015). When selecting the tools to implement, policymakers need to base their decisions on their efficiency, the country's financial structure, its existing policies and characteristics (Quint & Rabanal 2013). This includes examining external factors, such as commodity prices and events in other countries, and how they influence policy effectiveness, especially if there is a strong dependency on foreign markets (Dlamini & Ngalawa, 2022). This comprehensive process would help to ensure that the macroprudential policies are designed well to align with the country's existing financial framework.

Past research done in South Africa explored policies such as the LTV ratio and countercyclical buffers but there remains scope to test the combined effects of these tools along with the monetary policy (Dlamini & Ngalawa, 2022; Liu & Molise, 2020; Nyati et al., 2023). Instruments, such as countercyclical buffers, proved to be more helpful in ensuring that banks' borrowing power is limited during such times, so that there is no acceleration of the booms (Claessens, 2015). A finding revealed that allowing interactions of macroprudential tools that are well designed would be valuable in slowing down house price booms and reducing risks from international shocks (Claessens et al., 2013; Lo Duca et al., 2023).

## 2.4. The Coordination Debate

The coordination of monetary and macroprudential policies remains an ongoing debate (Dlamini & Ngalawa, 2022). Some early contributors supported the idea of integrating macroprudential tools within the central bank framework to address financial externalities (Cecchetti, 2000; Borio & Lowe, 2002). Conversely, having separate mandates can become a risk, where anti-inflationary rate hikes might amplify a credit boom originating from a non-inflationary shock (Svensson, 2018). This implies that if the type of shock is not well identified and macroprudential tools are tightened, it could worsen a recession caused by a decline in productivity (Iacoviello, 2005). However, this view was challenged by subsequent research, which found little benefit in coordination during real economic stress (Nyati et al., 2023). Although this debate predates the 2007 financial crisis, it had renewed attention following the global financial market downturn (Kannan et al., 2009).

Ultimately, this lack of consensus in literature presents challenges for policymakers, as inconsistent frameworks could result in poorly designed policies that threaten the economy and increase financial volatility.

Cross-country findings reveal that when advanced economies adjust their interest rates, it creates spillover effects on other nations (Nissinen, 2024). However, countries like Chile and Mexico counteract these effects by implementing macroprudential policies to mitigate the impact (Bussière

et al., 2021). Earlier research indicated that raising interest rates to reduce housing booms could amplify the economic cycle if that cycle was driven by productivity gains (Kannan et al., 2009). To avoid mistakes that could amplify these booms, it is essential to not only check the type of economic shock but also consider banking requirements, the characteristics of the banks, and the overall financial stability of the country (Liu & Molise, 2020). This highlights the need to tailor the combination of monetary policy and financial stability regulations to the specific context of each country, as speculative activities could lead to inflated prices and make things worse (Svensson, 2016).

When the central bank increases interest rates, it does not only affect inflation and growth, but also impact financial stability (Kim & Mehrotra, 2018). Likewise, tightening macroprudential policy does not only affect banks but may indirectly affect inflation and economic activity (Richte et al., 2018). This means that a decrease in interest rate could lead banks to increase their risk appetite (leading to risky borrowers) in hopes of higher returns (Dell'Ariccia et al., 2017). The spillovers observed into other goals show the need for coordination between the two policies. The problem would come from the differences in objectives of the two policies, which complicates coordination and is accompanied by trade-offs (Dlamini & Ngalawa, 2022). The trade-off that policymakers face in equilibrium is that an attempt to stabilise the economy (output/price) might conflict with financial stability (Danylyshyn & Bohdan, 2022).

Monetary policy works to support economic growth by adjusting interest rates, while macroprudential policy aims to maintain financial stability (Kannan, 2009). During economic uncertainty, the need for coordination between these two approaches becomes more critical (Svensson, 2018). Some findings argue that strict coordination may not always be necessary during typical business cycles, though it is essential in periods of financial stress to help prevent the two policies from working at cross purposes (Nyati et al., 2023). On the other hand, even among those who support the coordination, there is still no consensus on which policy should take the lead during periods of economic expansion (Dunstan, 2014; Spencer, 2014).

Most central banks implement monetary policy to manage economic booms and inflation; however, it falls short as a first line of defence in times of financial instability, as it does not directly

address the types or levels of credit risk (Lambertini et al., 2011). This limitation highlights the need for a macroprudential approach to protect the economy. While macroprudential tools can effectively respond to the credit-to-GDP ratio in times of financial distress, they may not be the best option that borrowers prefer, as it restricts their access to credit (Ferrando & Mulier, 2022).

Literature highlights the ongoing debate on the importance of coordination of the two policies, with some asserting that asset prices should not factor into monetary policy rules, while others contend that central banks ought to respond to asset prices (Bernanke & Gertler, 2001; Cecchetti & Krause, 2002; Kannan et al., 2009). Given that historically, the central bank mostly played a part in economic growth and interest rate adjustments, it is worthwhile to examine whether certain types of shocks require a more active response than monetary policy alone can provide.

The financial crisis did not only spark conversations around the need for macroprudential policies and the need to coordinate them with traditional monetary policy, it also brought researchers to a point of thinking of new policy instruments that would be more efficient in financial stability (Paoli & Paustian, 2017; Rubio & Carrasco-Gallegoy, 2014). The need for efficiency and the right application or tool is the reason this paper will test the combination of two macroprudential tools in the context of South Africa.

Although some prior studies established the importance of coordination between monetary and macroprudential policies, their findings are largely focused on advanced economies (Kannan et al., 2009; Lambertini et al., 2011; Lo Duca et al., 2023). These policies have the potential to have an impact on the other's domain. For instance, monetary policy can influence financial stability by changing the risk appetite of banks, while macroprudential policy could hinder overall economic growth by restricting borrowing and spending (Claessens, 2015).

## 2.5. How Literature Informs the Model Choice

The literature reviewed in this chapter directly informs the choice of a Dynamic Stochastic General Equilibrium (DSGE) framework for this study. First, the financial accelerator mechanism

(Bernanke et al., 1996; Iacoviello, 2005) needs a model that can handle financial frictions and collateral constraints. DSGE models capture feedback loops between the real economy and financial sector. Second, monetary policy analysis requires a framework where forward-looking agents form expectations and policy rules can be tested. DSGE models provide this through micro-foundations and explicit treatment of expectations. Third, the analysis of macroprudential tools highlights the need to model both borrower behaviour (demand for loans, affected by LTV) and bank balance sheets (supply of credit, affected by CCyB). A DSGE model can be calibrated to include both of these features, making it possible to simulate the effects of a composite macroprudential index. Finally, the coordination debate underscores the importance of understanding policy interactions and trade-offs precisely the kind of counterfactual analysis that DSGE simulations enable. Therefore, the DSGE methodology is a direct response to the theoretical and empirical complexities highlighted by the literature.

Literature on South Africa provides evidence on housing market dynamics (Das et al., 2011; Dlamini & Ngalawa, 2022; Gupta & Kabundi, 2009). However, it lacks a thorough analysis of the coordination between monetary policy and macroprudential policy that addresses both the demand and supply sides of credit simultaneously. Existing studies typically examine individual tools (such as LTV or CCyB in isolation) or focus on advanced economies where financial structures differ markedly from emerging markets (Kannan et al., 2009; Lambertini et al., 2011; Lo Duca et al., 2023). This study bridges this gap by employing a DSGE model calibrated to the South African context to analyse the coordination between monetary policy and a macroprudential composite index. This index comprises both the Loan-to-Value (LTV) ratio and the Countercyclical Capital Buffer (CCyB), allowing regulators to simultaneously influence both the demand for loans (through LTV) and the supply of credit (through CCyB). This represents an innovation for South Africa. The research seeks not only to contribute to the literature but also to offer policymakers an evidence-based framework to safeguard the country's financial stability. The DSGE framework developed in Chapter 3 is specifically designed to address this gap, allowing for a systematic evaluation of how monetary policy should coordinate with a composite macroprudential index in the South African context.

# Chapter Three

## 3. The Model Setup

The study employs a New Keynesian DSGE model in a closed-economy setting. This specification is a deliberate methodological choice aligned with the paper's primary objective to evaluate the coordination and effectiveness of monetary and macroprudential policies in shaping domestic credit and housing market dynamics. The framework is therefore designed to isolate internal policy transmission mechanisms and provide clear identification of how domestic policy instruments jointly influence credit conditions and housing market outcomes. This approach follows a well-established tradition in the DSGE literature, particularly for South African applications. Liu and Molise (2020) adopt the same specification to examine monetary–macroprudential policy interactions in South Africa, providing the direct foundation for this study. Gupta et al. (2015) and Liu (2013) further demonstrate that closed-economy frameworks yield valuable insights into South Africa's domestic dynamics without compromising analytical rigor.

Structural features of South Africa's financial system make this specification empirically appropriate. Liu and Molise (2020) document limited foreign-currency exposure in banking sector liabilities and assets. The International Monetary Fund (2022) confirms limited foreign-currency liability exposure within the banking system. Natarajan et al. (2022) highlight that South Africa's capital-flow management framework constrains foreign-currency-denominated lending risks. The South African Reserve Bank (2022) reports that public debt is overwhelmingly rand-denominated and financed through deep domestic capital markets. These institutional characteristics mean that domestic credit conditions are shaped predominantly by internal factors, making the closed economy assumption empirically appropriate for the policy questions addressed in the study.

The closed-economy specification is a deliberate methodological choice that prioritises internal consistency and clear identification of domestic policy interactions. This choice comes with the

limitation that it abstracts from South Africa's integration into global financial markets, including international risk sentiment, foreign interest rates, and capital flows (Rey, 2015; Bussière et al., 2021). However, this abstraction is intentional: it ensures that the policy interactions under investigation are not conflated with external disturbances, allowing for a clear assessment of how monetary and macroprudential tools jointly influence domestic credit and housing markets. The results therefore provide meaningful insights into the joint influence of monetary and macroprudential tools on credit and housing markets, offering a foundation for future research that incorporates external shocks.

The model is extended by the inclusion of the housing market and financial sector to analyse the interaction of macroprudential and monetary policy in South Africa. Within this model, the agents are firms, banks, the central bank, patient households (savers) and impatient households (borrowers). The framework builds upon the modelling strategy of Iacoviello (2005), Kannan et al. (2009) and Liu & Molise (2020) but introduces key modifications to policy instrument design.

This model makes use of housing as the primary asset, given that it accounts for a significant share of the overall household's wealth and is a key component of collateral in SA's credit market (South African Reserve Bank, 2024). Consequently, fluctuations within the housing sector have a higher probability of directly affecting households' net worth and the whole economy's financial stability. Within the model, households derive utility from consumption, housing services and disutility from labour. The savers deposit funds in the bank and get interest return from these deposits. Impatient households and entrepreneurs borrow funds from the bank and have a higher rate of time preference. However, they are constrained by the value of their housing asset, which therefore is the collateral that could bring a financial accelerator mechanism (Kiyotaki & Moore, 1997; Iacoviello, 2005). This study also includes the non-performing loans (NPLs), which behave inversely to output and create a feedback loop between financial confidence and the economy (Bouvatier & Lepetit, 2012).

Contrary to the Liu and Molise (2020) model, which introduces the LTV only as an exogenous shock, the model in this study incorporates it as an active macroprudential tool. This design accounts for simultaneous analysis of both the credit demand restrictions (via LTV cap) and supply

restrictions (via CCyB) (Angelin et al., 2014; Claessens, 2015). The banking sector acts as an intermediary between savers and borrowers; however, it faces a capital requirement constraint, which acts as a buffer against losses (Dlamini & Ngalawa, 2022). This puts a restriction on the amount that banks can lend to borrowers and the deposits they can take from savers (Liu & Molise, 2020). The central bank enters the model as the source that sets the monetary and macroprudential policies to ensure stability and growth. Entrepreneurs are producers of intermediate goods and consumers of final goods; however, they also borrow from the bank (Kannan et al., 2009). Retailers who bring price rigidities buy intermediate goods and transform them into final goods.

## 3.1. Impatient Households (Borrowers)

Borrowers are impatient household agents who face a binding credit constraint and require collateral to acquire loans (Angelini et al., 2014; Dlamini & Ngalawa, 2022; Gupta & Sun, 2020). In this model, the collateral is assumed to be the housing asset. The borrower maximises an intertemporal utility function given by

$$E_0 \sum_{t=0}^{\infty} \beta_b^t \left[ (1-\eta_b) \log(C_{b,t} - \eta_b C_{b,t-1}) + jA_{j,t} \log(H_{b,t}) + \tau \log(1-N_{b,t}) \right]$$

Here, the $\beta_b^t \in (0,1)$ represents the borrower's subjective discount factor, which is less than that of patient households (savers). This shows their desire to borrow against their future income is higher and allows for the constraints to be binding in equilibrium. They derive utility from consumption, $C_{b,t}$ which is also subject to habit formation that as shown by $\eta_b$. This indicates that past consumption influences current utility as determined by $\eta_b$, which shows the degree of habit persistence and allows for the marginal utility of consumption to be independent in the steady state. The borrower also derives utility from housing services $H_{b,t}$, and these have a weight $j$. The $\tau$ is the weight of leisure where $N_{b,t}$ is hours worked.

The impatient household faces a budget constraint that reflects their income and expenses

$$C_{b,t} + \frac{R_{b,t-1}}{\pi_t}(1 - \zeta_{b,t}(1 - \vartheta_b))L_{b,t-1} + Q_t(H_{b,t} - H_{b,t-1}) \; = \; W_{b,t}\, N_{b,t} + L_{b,t}$$

Where $L_{b,t}$ represents loans that they get from the bank, and they pay an interest rate of $\frac{R_{b,t-1}}{\pi_t}$ where the $\pi_t = \frac{P_t}{P_{t-1}}$ shows the inflation adjustment. House prices are shown by $Q_t = \frac{q_t}{P_t}$ while $H_{b,t} - H_{b,t-1}$ shows the housing stock change overtime and real wage is $W_{b,t}$. The model includes non-performing loans (NPLs) denoted by $\zeta_{b,t}$. It represents a partial default from loan contracts, and can bring indirect wealth benefits when borrowers repay lower than the contract repayment amount (Liu & Molise, 2020). The parameter $\vartheta_b$ is the amount that borrowers pay when they default and this also accounts for factors such as legal fees.

The borrowers face a collateral constraint whereby they can only borrow less than or equal the value of their collateral

$$L_{b,t} \leq m_b E_t(\frac{Q_{t+1}\pi_{t+1}}{R_{b,t}} H_{b,t})\gamma_{b,t}$$

Within the collateral, $m_b \in (0,1)$ is the loan-to-value (LTV) ratio. Then $\gamma_{b,t}$ represents an exogenous shock to the capacity that they can borrow; therefore, it affects the valuation of the collateral asset. It is often interpreted as a shock to lenders' confidence.

## 3.2. Patient Households (Savers)

The representative patient households are savers who deposit funds in the bank. They maximise their expected discounted lifetime utility, which is given by:

$$E_0 \sum_{t=0}^{\infty} \beta_s^t [(1 - \eta_s) \log(C_{s,t} - \eta_s C_{s,t-1}) + jA_{j,t} \log\big(H_{s,t}\big) + \tau \log(1 - N_{s,t})]$$

This utility function parameters are closely similar to that of the borrowers. However, $\beta_s^t > \beta_b^t$, which means patient households are more patient and therefore, are net savers in equilibrium. $A_{j,t}$ is a housing preference shock that follows an autoregressive process and captures changes in preferences or credit conditions. Here $\eta_s$ denotes the habit persistence in consumption, meaning the closer it is to 1, the more current consumption depends on past consumption levels. *j* represents the weight on housing services $H_{s,t}$, while $\tau$ denotes preferences for leisure $(1 - N_{s,t})$, to ensure that the patient households optimally split time between labour and rest.

The budget constraint for these household is

$$C_{s,t} + D_t \ + Q_t \left(H_{s,t} - H_{s,t-1}\right) = W_{s,t}N_{s,t} + \frac{R_{t-1}}{\pi_t}D_{t-1} + F_{s,t}$$

Where $D_t$ denotes the deposits made by households to the bank, and these are interest-bearing assets that earn a real gross return of $\frac{R_{t-1}}{\pi_t}$. The households act as both consumers of housing services as well as investors in the housing services. The patient households receive $F_{s,t} = (X_t^{-1} - 1)Y_t$, which are profits from retail firms. Here $X_t$ represents the markup set by retailers, and $Y_t$ is aggregate output. Patient households act as net suppliers of funds in the credit market and are not constrained in their borrowing.

## 3.3. Entrepreneurs

Entrepreneurs produce intermediate goods and require external financing for their operations. They maximise expected discounted utility from consumption, which is given by:

$$E_0 \sum_{t=0}^{\infty} \beta_e^t \left[(1 - \eta_e) \log\left(C_{e,t} - \eta_e C_{e,t-1}\right)\right]$$

$\beta_e^t < \beta_s^t$ means that entrepreneurs are net borrowers in equilibrium, this is because they have a higher preference for present consumption relative to savers. The consumption $C_{e,t}$ represents

profits or dividends, while $\eta_e$ is habit persistence showing how current consumption is influenced by past consumption.

The entrepreneurs work under a constant return to scale Cobb-Douglas production technology and their production function is given by:

$$Y_t(z) = Z_t H_{e,t-1}\,(z)^{v}\left[N_{s,t}\,(z)^{1-\sigma}\,N_{b,t}(z)^{\sigma}\,\right]^{1-v}$$

where $v \in (0,1)$ shows the elasticity of output with respect to housing and $\sigma \in (0,1)$ is the relative share of borrowers' labour in production. The technology shock $Z_t$ is modelled as an autoregressive process which shoes productivity changes overtime.

The entrepreneur's budget constraint is

$$C_{e,t} + Q_t\left(H_{e,t} - H_{e,t-1}\right) + \frac{R_{e,t}}{\pi_t}\left(1 - \zeta_{e,t}(1-\vartheta_e)\right)L_{e,t-1} + W_{s,t}N_{s,t} + W_{b,t}N_{b,t} = \frac{1}{X_t}Y_t + L_{e,t}$$

From this $L_{e,t}$, shows loans that entrepreneurs acquire, while $Q_t\left(H_{e,t} - H_{e,t-1}\right)$ shows changes in their housing stock which they can use as collateral.

Entrepreneurs face a borrowing constraint similar to households

$$L_{e,t} \;\leq\; m_e E_t\left(\frac{Q_{t+1}\pi_{t+1}}{R_{e,t+1}}H_{e,t}\right)\gamma_{e,t}$$

where $m_e$ denotes the LTV ratio for entrepreneurs which shows maximum amount borrowers can access relative to their housing collateral. $\gamma_{e,t}$ represents the shocks borrowing capacity of the entrepreneur.

## 3.4. Financial Intermediaries (Banks)

The primary role of the banking sector is to intermediate funds between savers and borrowers. It is subject to capital requirements restrictions which restrict the lending ability (Dlamini & Ngalawa, 2022). The bank is owned by shareholders and maximises utility from its profits (dividends). The expected discounted utility function for the bank is:

$$E_0 \sum_{t=0}^{\infty} \beta_f^t = [(1-\eta_f)\log(C_{f,t} - \eta_f C_{f,t-1})]$$

where $\beta_f^t \in (0,1)$ is the bank's subjective discount factor which is assumed to be less than of savers ($\beta_f^t < \beta_s^t$). It means that the capital requirement constraint is binding in the steady state. The bank's budget constraint incorporates loan portfolio adjustment costs:

$$C_{f,t} + \frac{R_{t-1}}{\pi_t} D_{t-1} + L_{b,t} + L_{e,t} + AC_b f_t + AC_e f_t = D_t + \frac{R_{b,t-1}}{\pi_t}(1-\zeta_{b,t})L_{b,t-1} + \frac{R_{e,t-1}}{\pi_t}(1-\zeta_{e,t})L_{e,t-1}$$

Where $AC_b f_t = \left(\frac{\varphi_b f}{2}\right)\left(\frac{(L_{b,t}-L_{b,t-1})^2}{L_b}\right)$ and $AC_e f_t = \left(\frac{\varphi_e f}{2}\right)\left(\frac{(L_{e,t}-L_{e,t-1})^2}{L_e}\right)$ represent quadratic adjustment costs for household and entrepreneur loan portfolios, respectively.

The bank experiences a capital requirement constraint similar to Basel III rules, meaning that bank capital must exceed a fraction $\kappa$ of risk-weighted assets (Dlamini & Ngalawa, 2022). The constraint is given by:

$$\frac{L_{b,t-1} + L_{e,t} - E_t[\zeta_{t+1}] - D_t}{\omega_b(L_{b,t-1} - E_t[\zeta_{b,t+1}]) + \omega_e(L_{e,t} - E_t[\zeta_{e,t+1}])} \geq \kappa_t$$

Where $\omega_b$ and $\omega_e$ are risk weights for household and entrepreneur loans, respectively, and denote different degrees of risk associated with each loan type.

This constraint can also be rewritten as a limit on the deposits the bank accepts:

$$D_t \geq (1-\omega_b\kappa_t)(L_{b,t} - E_t[\frac{R_{b,t}}{\pi_{t+1}}\zeta_{b,t+1}L_{b,t}]) + (1-\omega_e\kappa_t)(L_{e,t-} E_t[\frac{R_{e,t+1}}{\pi_{t+1}}\zeta_{e,t+1}L_{e,t-1}]) -$$

## 3.5. Retailers

Firms are assumed to be under monopolistic competition, which means that prices are sticky and do not adjust immediately to changes in economic conditions (Smets & Wouters, 2007). Retailers buy homogeneous intermediate goods from entrepreneurs at the wholesale price and differentiate them at zero cost to have product differences. Price setting is characterised by Calvo rigidity, whereby a fraction $(1-\theta)$ of firms set prices optimally each period. The remaining $\theta$ fraction of retailers cannot re-optimise their prices and instead index their prices to past inflation, with a sensitivity parameter governed by $\iota_p$.

This price-setting behaviour generates a New Keynesian Phillips curve showing the relation between inflation and output gap:

$$\hat{\pi}_t = \frac{\iota_p}{1+\iota_p\beta_s}\hat{\pi}_{t-1} + \frac{\beta_s}{1+\iota_p\beta_s}E_t\hat{\pi}_{t+1} - \frac{(1-\theta)(1-\beta_s\theta)}{\theta(1+i_p\beta_s)}\hat{x}_t + \xi_{\pi,t}$$

where variables with hats denote log deviations from steady state, and $\xi_{\pi,t}$ shows a cost-push shock affecting inflation independent of demand, such as supply-side shocks.

## 3.6. Macroprudential and Monetary Policy

This paper evaluates three policy regimes to assess the coordination between monetary and macroprudential tools. The central bank is responsible for implementing both monetary and macroprudential policies which are made to stabilize the economy. One of the macroprudential instruments in this model is the countercyclical capital buffer (CCyB) that adjusts the regulatory capital requirement ratio in response to credit cycles. It allows banks to acquire more capital during economic booms, which can then be used to cushion losses during economic downturns, to help stabilise credit supply. The CCyB is modelled as:

$$\kappa_t = \kappa_{ss} + \chi lk \left(\frac{L_t/Y_t}{L/Y} - 1\right) + \varepsilon_t^{\kappa}$$

where $\kappa_{ss}$ is the steady-state capital requirement ratio, $\chi lk$ is the policy response coefficient which measures the responsiveness of CCyB to deviation of credit-to-GDP from its long run trend, and $\varepsilon_t^{\kappa}$ denotes discretionary adjustments to capital requirements.

The baseline Taylor rule, where the central bank sets the policy rate only based on output and inflation, is represented as:

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\gamma r} \left[\left(\frac{\pi_t}{\pi}\right)^{\gamma \pi} \left(\frac{Y_t}{Y_{t-1}}\right)^{\gamma y}\right]^{1-\gamma r} e^{\xi_{r,t}}$$

Monetary policy that follows an augmented Taylor rule and incorporates a macroprudential policy index (MPI). Central bank adjusts the policy rate, not only in response to inflation and output, but also to changes in financial stability, as represented by the MPI. This is modelled as:

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\gamma r} \left[\left(\frac{\pi_t}{\pi}\right)^{\gamma \pi} \left(\frac{Y_t}{Y_{t-1}}\right)^{\gamma y} (MPI_t)^{\gamma mpi}\right]^{1-\gamma r} e^{\xi_{r,t}}$$

where $\gamma r$ is the interest-rate smoothing parameter showing central bank's preference for gradual adjustments in the interest rate, $\gamma\pi$ and $\gamma y$ are policy response coefficients to inflation and output. The $\gamma mpi$ is the policy response coefficient to MPI which shows the "lean against the wind" response to financial imbalances.

The Macroprudential Policy Index (MPI) is modelled as a composite indicator which combines the LTV ratio and CCyB. It shows the central bank's efforts to balance financial stability with economic activity. The MPI is modelled as:

$$MPI_t = \alpha_{ltv} \cdot \left(\frac{m_b + m_e}{2}\right) + \alpha_\kappa \cdot \kappa_t$$

Where $\alpha_{ltv}$ and $\alpha_\kappa$ are weights assigned to LTV and CCyB in the MPI. The terms $m_b$ and $m_e$ are loan-to-value ratios of borrowers and entrepreneurs, respectively, while $\kappa_t$ denotes the CCyB.

## 3.7. Market Clearing

In this model, equilibrium requires that all markets clear. The aggregate resource constraint states that output equals the sum of consumption by all agents plus adjustment costs related to lending and borrowing:

$$Y_t = C_{s,t} + C_{b,t} + C_{e,t} + Cf_t + AC_{bf,t} + AC_{ef,t}$$

where $AC_{bf,t} + AC_{ef,t}$ represents total adjustment costs of household and entrepreneur loan portfolios.

Furthermore, the housing market must also clear and it requires that total housing demand across all agents must equals the fixed housing supply, which is normalised to 1 in the model:

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

In the credit market, total loan supply must equal total demand from both borrower types (impatient households and entrepreneurs):

$$L_t = L_{b,t} + L_{e,t}$$

The market clears when the supply of deposits from patient households matches the bank's demand for them. Simultaneously, the labour market clears as the total labour supplied by both patient and impatient households' equals the total labour demanded by entrepreneurs. This leads to a full employment in the model.

## 3.8. Loan-to-Value (LTV) and Countercyclical Capital Buffer (CCyB) shocks

The Loan-to-Value (LTV) was previously added as an exogenous financial shock to simulate changes in lending standards (Liu & Molise, 2020). Having the two policies combined would be helpful in dealing with any shocks that could come from the other macroprudential policies. Since the Countercyclical Capital Buffer (CCyB) ratio is a lender-based tool, this shock was shown to be effective in mitigating LTV effects without compromising price stability (Dlamini & Ngalawa, 2022). This paper therefore aims to combine the LTV and CCyB as active policy tools and not only as sources of shocks. This is to test if there is a potential of making the other tool deal with any effects that could come from the other tool or its associated shocks. This will allow the policymaker to use two instruments (LTV and CCyB) within a single index, making macroprudential policy more flexible and responsive to both the supply and demand sides of credit.

The model also includes exogenous shocks coming from each of the policies. For example, the LTV shock would represent a sudden announcement by the regulator that there is a reduction in LTV ratio on all mortgages from 80% to 70%. For the CCyB shock, this can arise from financial crisis where the regulator decides to decrease CCyB to stabilise the banking sector. Including these shocks makes the model more realistic as it allows unexpected changes in policy showing how real world has uncertainty and volatility. It removes the idea that financial agents and borrowers always know which macroprudential policy will be implemented next.

## 3.9. Policy Regimes

Three different types of policy regimes are evaluated in the model, where each shows different approach to monetary and macroprudential policy. Regime I serves as the baseline, defined by the standard Taylor rule for the policy rate and a constant capital requirement ratio, without implementing active macroprudential measures. In this regime, the capital requirement does not adjust in response to changes in credit or output. Regime II expands on the baseline by incorporating a macroprudential composite index (MPI), which includes a combination of loan-to-value (LTV) ratios and a countercyclical buffer (CCyB) variable. In this regime, monetary policy still follows the standard Taylor rule, while the macroprudential tool addresses collateral constraints faced by households and entrepreneurs, ultimately protecting the banking sector from excessive fluctuations in credit.

Policy Regime III incorporates an augmented Taylor rule combined with the MPI. This regime modifies the Taylor rule to respond to inflation, output gaps, and credit growth. By using the combined LTV and CCyB variable, it ensures that both collateral constraints and capital requirements are taken into account. This reflects a coordinated approach to monetary and macroprudential policies that targets credit dynamics and promotes financial stability.

## 3.10. Calibration

Table 1 presents the calibration of the model, showing parameter values for the South African closed economy. These values are calibrated in accordance with existing studies (Balcilar et al., 2017; Dlamini & Ngalawa, 2022; Du Plessis et al., 2014; Gupta & Sun, 2020; Liu & Molise, 2020).

*Table 1: Parameter calibration*

| **Parameter** | **Value** | **Symbol** | **Parameter** | **Value** | **Symbol** |
|---|---|---|---|---|---|
| Saver discount factor | 0.995 | $\beta_s$ | Calvo price stickiness | 0.75 | $\theta$ |
| Borrower discount factor | 0.97 | $\beta_b$ | Price indexation | 0.5 | $\iota_\pi$ |
| Entrepreneur discount | 0.96 | $\beta_e$ | Steady state inflation | 1.016 | $\pi$ |
| Bank discount factor | 0.95 | $\beta_f$ | Steady state markup | 1.1 | $X$ |
| Habit persistence | 0.5 | $\eta$ | CCyB shock persistence | 0.8 | $\rho_{ccyb}$ |
| Housing preference | 0.12 | $j$ | Household LTV shock | 0.75 | $\rho_{LTV_b}$ |
| Housing share in output | 0.1 | $\nu$ | Entrepreneur LTV shock | 0.75 | $\rho_{LTV_e}$ |
| Labour supply | 2 | $\tau$ | Technology shock | 0.914 | $Z_t$ |
| Borrower labour share | 0.4 | $\sigma$ | Weight on LTV | 0.6 | $\omega_{ltv}$ |
| Steady state LTV ratio (*hh*) | 0.8 | $m_b$ | Weight on CCyB | 0.4 | $\omega_{ccyb}$ |
| Steady state LTV ratio (*entrepr.*) | 0.6 | $m_e$ | Policy (*credit growth*) | 0.5 | $\varphi_{MPI_l}$ |
| Steady state ratio (*capital requirement*) | 0.13 | $\kappa$ | Policy (*output gap*) | 0.3 | $\varphi_{MPI_y}$ |
| Risk weight (*hh*) | 1 | $\omega_b$ | Interest smoothing | 0.83 | $\gamma_r$ |
| Risk weight (*entrepr.*) | 1 | $\omega_e$ | Inflation response | 1.7 | $\gamma_\pi$ |
| NPL ratio (*hh*) | 0.04 | $\zeta_b$ | Output response | 0.25 | $\gamma_y$ |
| NPL ratio (*entrepr.*) | 0.034 | $\zeta_e$ | Housing demand shock | 0.1 | $\sigma_j$ |

The discount factors for savers, borrowers, entrepreneurs, and banks are set at $\beta_s = 0.995, \beta_b = 0.97, \beta_e = 0.96, \beta_f = 0.95$, respectively (Dlamini & Ngalawa, 2022; Liu & Molise, 2020). These values ensure borrowing constraints bind in the steady state. Housing preference (j = 0.12) and housing share in production (ν = 0.1) are taken from Liu and Molise (2020) to match housing wealth-to-GDP in South Africa. Steady-state inflation (π = 1.016) aligns with the SARB target range, while the markup (X = 1.1) reflects a standard 10 per cent retail markup.

The household LTV ratio ($m_b = 0.8$) and entrepreneur LTV ratio ($m_e = 0.6$) reflect typical South African borrowing constraints (Liu & Molise, 2020). The capital requirement (κ = 0.13) is based on SARB historical averages. Non-performing loan ratios ($\zeta_b = 0.04, \zeta_e = 0.034$) match South African data, while borrower labour share (σ = 0.4) follows Dlamini and Ngalawa (2022). Monetary policy parameters ($\gamma_r = 0.83, \gamma_\pi = 1.7, \gamma_y = 0.25$) are taken from Du Plessis et al. (2014).

Technology shock persistence ($Z_t = 0.914$) and housing demand shock volatility ($\sigma_j$ = 0.1) are drawn from Liu and Molise (2020). These calibrated values ensure the model generates dynamics consistent with South African business cycle properties, enabling a meaningful analysis of policy coordination across the three regimes.

# Chapter Four

## 4.1. Eigen Values

The eigenvalue analysis in Table 2 is helpful for assessing the stability and dynamics of the DSGE model. They show the response to shocks and whether it will return to equilibrium, diverge, or cycle perpetually.

The modulus, or distance from the origin, is key for stability assessment. A modulus less than one means that the dynamic component will diminish over time, driving the system back to equilibrium, while a modulus greater than one signals that the system will become unstable (Alvarez & Lippi, 2022). However, a modulus equal to one suggests a unit root, meaning the shock has a permanent effect and the variable will not return to its original steady-state value (Esposti & Listorti, 2013).

Eigenvalues in Table 2 can be categorized into several groups since they show different aspects of the system's behaviour. The first group has values very close to zero. These represent fast-moving variables that adjust almost instantly to shocks and do not affect the model's stability (Christensen & Dib, 2008). The second group has values well below one. These are the most important for stability as they show that most of the system returns to equilibrium after a shock. These moduli are helpful since they ensure that the model’s dynamics reflect the persistence and adjustment observed in the real world (Meyer-Gohde, 2024).

A few eigenvalues are slightly above one This means that after some shocks, the economy takes longer to return to normal and may show hump-shaped patterns. This is exactly what the financial accelerator theory predicts: credit and collateral create feedback loops that slow down adjustment (Bernanke et al., 1999; Iacoviello, 2005). It also shows why financial systems need active policy such as Regimes II and III to keep things stable. The model remains reliable for comparing policies, and this mild instability supports the need for macroprudential tools.

*Table 2: Eigen Values*

| **Modulus** | **Real** | **Imaginary** |
|---|---|---|
| 2.38E-18 | 2.38E-18 | 0 |
| 2.00E-17 | -2.00E-17 | 0 |
| 1.05E-16 | 1.05E-16 | 0 |
| 2.30E-16 | 2.30E-16 | 0 |
| 2.70E-16 | 2.70E-16 | 0 |
| 3.95E-16 | -3.95E-16 | 0 |
| 9.33E-16 | -9.33E-16 | 0 |
| 0.418 | 0.418 | 0 |
| 0.4814 | 0.4814 | 0 |
| 0.5011 | 0.5011 | 0 |
| 0.5396 | 0.5396 | 0 |
| 0.5557 | 0.5059 | 0.23 |
| 0.5557 | 0.5059 | -0.23 |
| 0.7391 | 0.7391 | 0 |
| 0.75 | 0.75 | 0 |
| 0.75 | 0.75 | 0 |
| 0.9 | 0.9 | 0 |
| 0.914 | 0.914 | 0 |
| 0.9462 | 0.9462 | 0 |
| 1.006 | 1.006 | 0 |
| 1.04 | 1.04 | 0 |
| 1.069 | 1.069 | 0 |
| 1.136 | 1.136 | 0 |
| 1.336 | 1.325 | 0.1688 |
| 1.336 | 1.325 | -0.1688 |
| 1.506 | -1.506 | 0 |
| 38.86 | 38.86 | 0 |
| 7.88E+17 | 7.88E+17 | 0 |
| 9.38E+17 | 9.38E+17 | 0 |
| 4.39E+19 | -4.39E+19 | 0 |

The analysis above shows the presence of complex conjugate pairs in the eigenvalues which introduce cyclical behaviour into the model's adjustment process. The first pair, with a modulus of 0.5557, show dampened fluctuations. After a shock, some variables may temporarily go beyond their normal levels and show business cycle-like movements before gradually returning to balance. This behaviour allows for hump-shaped responses as mostly seen in prior literature which capture the fluctuations of economic variables (Christensen & Dib, 2008). The second complex pair, with a modulus of 1.336, represents a locally explosive root that could potentially cause the model to be unstable.

The eigenvalue analysis shows that the model is stable and reliable. Overall, the model's ability to handle both short-term fluctuations and long-term mean reversion ensures its results are useful for policy analysis.

## 4.2. Impulse Response Functions

Figure 1 shows the impulse response functions (IRFs) that illustrate effects of a housing demand shock in the South African economy under three different policy regimes. These are namely, regime 1 with only the monetary policy, regime 2 with monetary policy and macroprudential policy and regime 3 which contains augmented monetary policy and macroprudential policy.

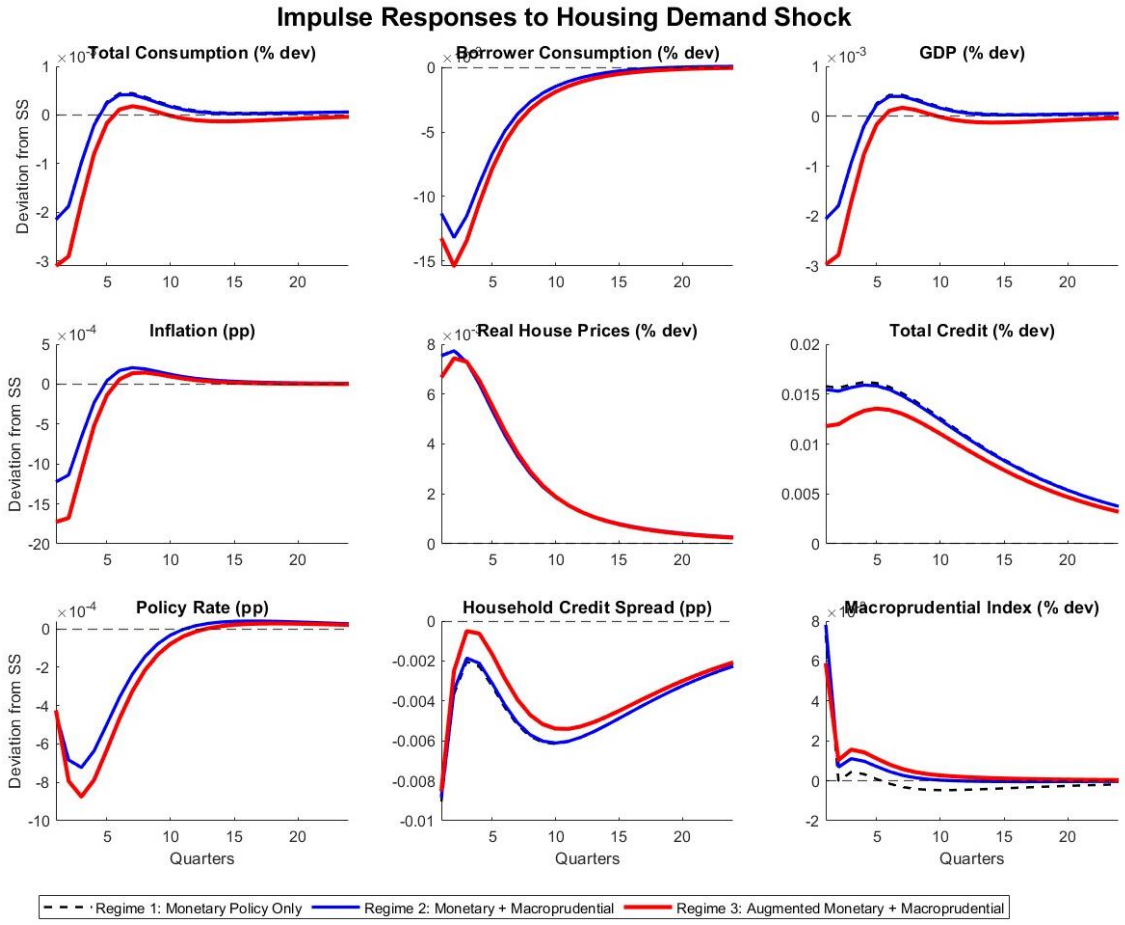


*Figure 1: Impulse response to housing demand shock*

The housing demand shocks are often driven by increased household optimism, or easier access to credit which increases the marginal utility of housing services (Iacoviello, 2005). This, in turn, causes real house prices to jump sharply across all regimes, as shown in the figure 1. From regime 1, the monetary policy response alone leads to a more pronounced boom in house prices which is

accompanied by an increase in credit, GDP, and the total consumption. As borrowing capacity increases, it fuels a credit boom, which is evident in the initial rising total credit (as shown in Figure 1). This, in turn, stimulates consumption and economic growth, contributing to the overall expansion. However, as shown in the graph, the credit growth driven by the rise in house prices is inherently risky, contributing to inflationary pressures (indicated by the sharp rise in inflation in the left panel of Figure 1), which is supported by past research (Kakuru & Kaulihowa, 2022; Zevelev, 2021). In response to this, the South African Reserve Bank (SARB) raises the policy rate, but this action fails to mitigate the underlying credit boom. Borio (2003) underscores the limitations of relying solely on monetary policy to manage financial imbalances, particularly when house prices are a central factor driving economic activity.

This case mirrors the dilemma discussed by Borio & Zhu (2008), who argue that while monetary tightening (as seen in the policy rate response in Regime 1, Figure 1) may help to control inflation, but does not effectively mitigate the financial imbalances resulting from rapid credit growth. Thus, Regime 1 underscores the vulnerability of relying solely on monetary policy to stabilise housing market booms a concern widely acknowledged in the literature (Mishkin, 2007; Duca et al., 2021).

As shown in Figure 1 (blue line for Regime 2), where a composite macroprudential tool, called the Macroprudential Index (MPI), is introduced to address the credit boom. The Macroprudential Index (MPI) in Regime 2 shows an immediate tightening in response to the credit boom, with a sharp rise in the index as macroprudential tools are activated to curb credit expansion. This active use of LTV and CCyB tools directly addresses the source of the financial instability. By restricting both the demand for credit (via tighter LTV limits) and the supply of credit (via higher capital requirements for banks), the macroprudential policy successfully dampens the explosion of total credit compared to Regime 1 (Claessens et al., 2013). Consequently, the increase in house prices is mitigated, as the availability of financing is reduced. In Figure 1, the initial increases in GDP, consumption, and inflation are slightly tempered in Regime 2 compared to Regime 1, with GDP and consumption showing a more gradual rise and inflation being more moderate. The monetary policy response in this regime is less aggressive than in Regime 1 because the macroprudential tool is doing part of the work to contain the boom, and therefore reducing the inflationary pressure that the central bank must address alone. This illustrates the beginning of a coordinated response,

where macroprudential policy "leans against the wind" of the financial cycle, allowing monetary policy to remain more focused on its traditional objectives (Svensson, 2018).

The most effective stabilisation occurs under Regime 3 (red line in Figure 1), where both monetary and macroprudential policies are fully coordinated. In this regime, the combined tightening of the macroprudential index and augmented monetary policy directly responds to credit conditions. This results in a more rapid return to equilibrium in credit and housing markets, as shown by the credit IRF in Regime 3. The house price boom is more contained. Additionally, credit growth is sharply reduced, and this is shown by the quick flattening of the flattened credit curve. As a result, GDP and total consumption follow a smoother pattern compared to Regimes 1 and 2.

The finding in this paper aligns with the financial accelerator framework developed by Bernanke et al. (1996), which explains how falling asset prices reduce borrowers' collateral value, leading to tighter credit and amplifying economic downturns. When the amplification of credit growth is prevented in the first place, Regime 3 dampens the financial accelerator effect and reduces the potential for a deeper economic volatility. This is consistent with the findings that macroprudential policies are important for mitigating credit booms and busts (Cerutti et al., 2015). From Figure 1, Regime 3 effectively mitigates these boom-bust cycles by directly curbing both credit demand (through LTV restrictions) and supply (via CCyB).

The smoother economic trajectory in Regime 3, as seen in Figure 1, suggests substantial welfare gains since financial and macroeconomic stability reduces the risks faced by vulnerable households, mostly low-income borrowers who are more sensitive to credit conditions (Gupta & Kabundi, 2010; Iacoviello, 2005). The findings from past research on emerging markets supports this view, showing that coordinated policies can reduce the disproportionate impact of financial cycles on households with limited access to credit (Dlamini & Ngalawa, 2022)

This results from Figure 1 are consistent with prior findings which show that combining monetary policy with macroprudential instruments such as LTV limits and countercyclical capital buffers, helps produce a more stable macroeconomic environment with reduced inflationary pressures (Kannan et al., 2009; Lambertini et al., 2011). This is the conclusion derived under Regime 3.

Research further emphasizes that during episodes of financial stress, especially those driven by housing market booms, coordinating monetary and macroprudential policies is crucial to prevent the amplification of economic volatility (Svensson, 2018).

In the South African context, where inequality is high and the housing market is highly segmented (Das et al., 2011), the results reflect the value of coordinated policy action. The evidence from this model suggests that macroprudential interventions can cushion the effects of financial cycles on credit-constrained households, improving welfare by stabilising house prices and promoting fair access to credit (Dlamini & Ngalawa, 2022). This supports a broader body of work advocating for an integrated policy framework to strengthen financial stability, especially in emerging markets that have higher exposure to external shocks (Claessens, 2015; Bussière et al., 2021).

The housing demand shock results show the value of coordinated policy. To assess whether these conclusions hold across other economic environments, Figure 2 examines the effects of a positive technology shock, showing insights on how the source of a shock shapes policy effectiveness.

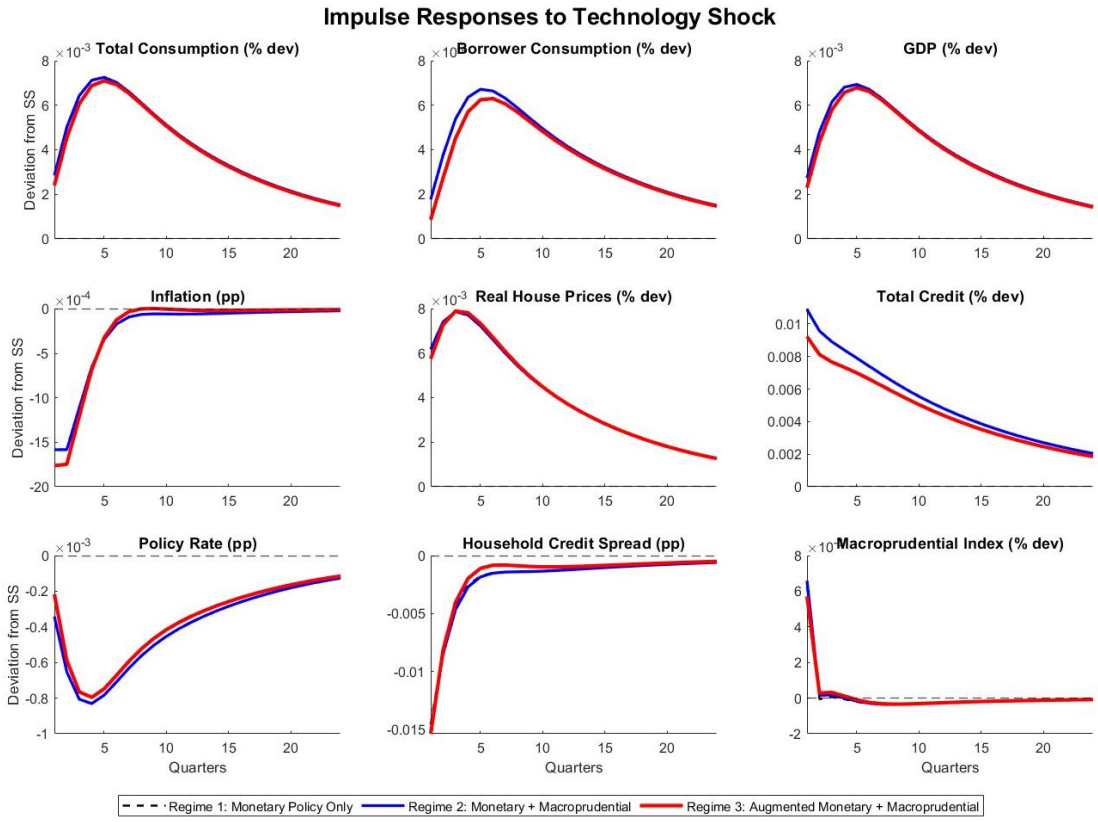


*Figure 2: Impulse responses to technology shock*

The positive technology shock increases the economy's productivity capacity and as seen on Figure 2 this immediately raises GDP, total consumption and borrower consumption in all regimes. This behaviour aligns with the standard New Keynesian theory which says that improving productivity improves income and reduces marginal production costs (Christiano et al., 2005; Smets & Wouters, 2007). From the IRFs, GDP and consumption graphs rise more strongly under regime 1 when monetary policy accommodates the shock by lowering the policy rate. From regime 2 and 3, this shows that there are weaker peaks, showing that macroprudential tightening restricts credit growth even though the expansion is productivity-driven. This response aligns with the finding that macroprudential rules can misinterpret benign credit growth as risk and then dampen economic benefits that originate from supply side shocks (Kannan et al., 2009).

The introduction of macroprudential policy under regime 2 and 3 leads to a less efficient adjustment to technology shock. As shown in Figure 2, the macroprudential index tightens immediately because it interprets the increase in credit as though it is an indication of growing financial risk whereas it is a normal outcome of increased productivity. When this is tightened very early it shows the increase in consumption and house prices and total credit relative to regime 1. In addition, the smaller interest rate reduction in regime 3 shows the issues that policies designed to "lean against the wind" can be counterproductive when credit growth is driven by productivity improvements rather than speculative imbalances (Adrian & Liang, 2018; Svensson, 2017).

Overall, the results underscore the warnings in the literature that policymakers must accurately identify the nature of economic fluctuations to avoid severe policy errors (Svensson, 2016). A one-size-fits-all approach to macroprudential policy can lead to unnecessary dampening of growth during periods of productivity-driven expansion. Therefore, an optimal policy framework requires a shock-dependent approach where macroprudential tools are used aggressively during financial booms but remain neutral or passive during periods of non-inflationary growth fuelled by positive supply shocks.

Figure 3 below shows the impulse response functions to an exogenous tightening of the Countercyclical Capital Buffer (CCyB). It gives an illustration of the transmission mechanism of a key macroprudential tool and its impact on the financial system and the economy.

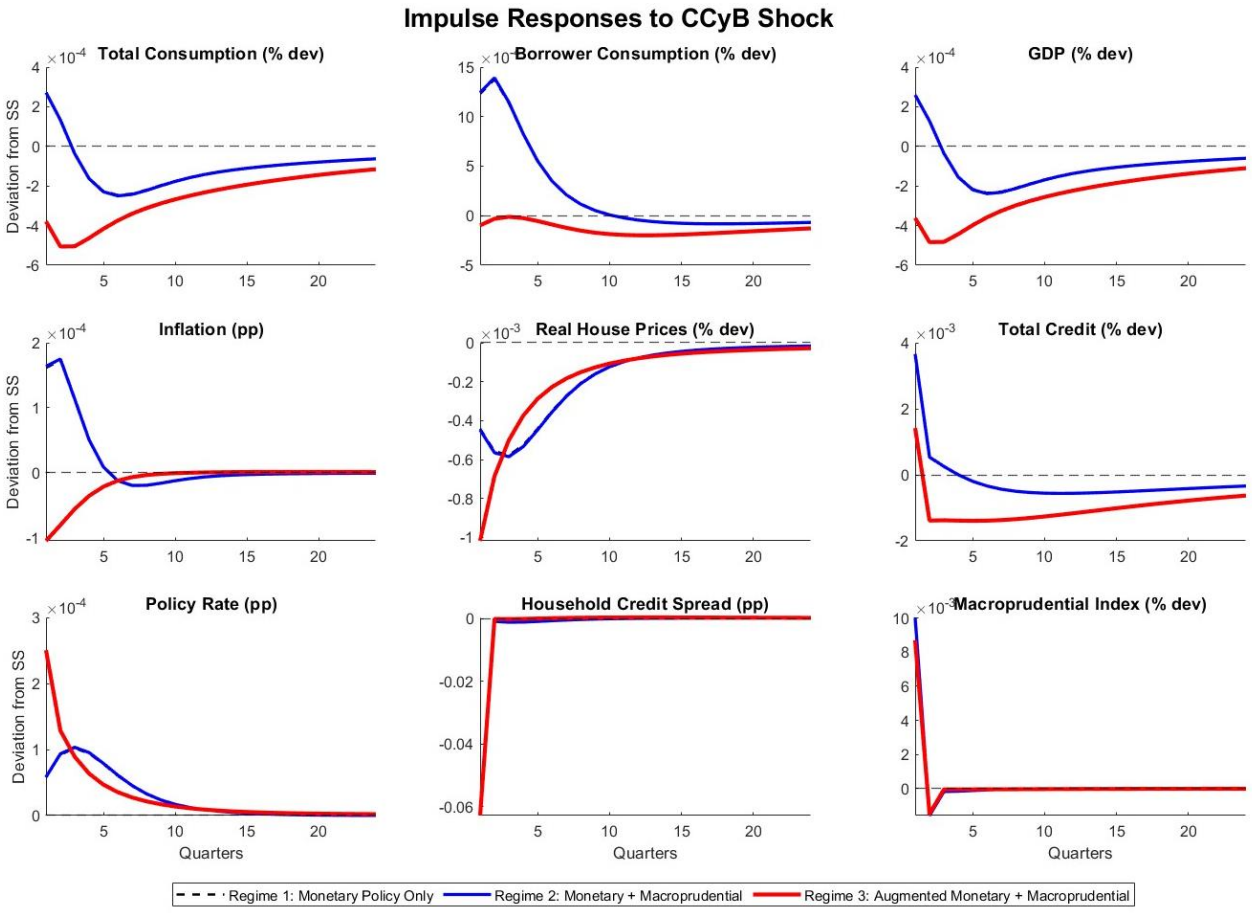


*Figure 3: Impulse responses to CCyB shock*

The impulse response functions to an exogenous tightening of the Countercyclical Capital Buffer (CCyB) give an illustration of the transmission mechanism of this macroprudential tool and its impact on the financial system and the economy. A CCyB shock in Figure 3 shows a regulatory decision to increase banks capital buffer relative to the risk weighted asset. When this happens, it leads to an increased cost of lending. This is a direct intervention on the credit supply which leads to more economic events that follow. The immediate impact is shown in IRFs by the contraction of total credit which is because which occurs because banks reduce lending to meet the higher capital requirements. The credit tightening causes a disruption on the financial accelerator

mechanism but in reverse, instead of increasing collateral values which leads to more borrowing, the constraint on lending puts downward pressure on asset prices (Bernanke et al., 1999).

The contraction in credit supply increases its cost, leading to a sharp rise in the household credit spread as seen in the IRF graph and it is because the risk premium banks charge over the policy rate. This widening spread reflects both higher funding costs for banks and a greater caution due to tighter regulations (Borio, 2003). When borrowing becomes more expensive and less accessible, households tend to cut back on investment and consumption, leading to a drop in overall demand as seen from the decrease in the consumption graph from Figure 3.

The outcomes differ based on how monetary policy responds across the three regimes. It shows that the broader policy framework can either amplify or soften the impact of macroprudential tightening. In Regime 1, where monetary policy operates in isolation under a standard Taylor rule, the central bank's response is straightforward. Upon observing a fall in inflation and output that is caused by the CCyB shock, the central bank lowers the policy rate. This accommodative response helps to partially offset the shock, easing the pressure on the real economy.

The response in Regime 2 is conceptually similar, though the initial macroprudential shock is an inherent part of this regime's structure. However, the most effective response is observed under Regime 3 which is the fully coordinated framework. Here, the monetary authority follows an augmented rule that integrates financial conditions. The findings suggest that the central bank in this regime does not only reacts to the decrease in inflation and output but also directly adjusts for macroprudential tightening. Central banks respond by cutting the policy rate more aggressively and swiftly than in the other regimes. This monetary easing acts as a stabiliser which softens the impact on consumption and GDP and ensuring a quicker return to the steady state. This shows that the negative short-term costs of a macroprudential tightening can be reduced when monetary policy is coordinated and designed to counterbalance the financial contraction (Svensson, 2018).

The analysis of the CCyB shock leads two fundamental conclusions for policymakers. First, it validates the CCyB as an important instrument that helps to cool the credit cycle. It is able to constrain the supply of credit and increase lending costs effectively to mitigating financial

volatility and make banking sector resilience during booms, as intended by its design under the Basel III framework (Claessens, 2015). However, the second conclusion is that the addition of this tool also comes at a cost, which includes a temporary decrease in GDP and consumption when this shock initially hits as seen on Figure 3. It means that a trade-off between pursuing financial stability and maintaining short-term economic activity.

In this framework, the macroprudential authority can act to address financial vulnerabilities, while the central bank, informed by a financial-augmented mandate, can actively mitigate the adverse macroeconomic side effects. This relationship allows the CCyB to "lean against the wind" of a credit boom while monetary policy "leans with the wind" of the resulting economic slowdown, thereby stabilising the broader economy (Svensson, 2018). For an emerging market like South Africa, vulnerable to capital flows and credit cycles volatility, the coordinated Regime 3 approach could help to protect the financial stability of the country without causing unnecessary economic volatility.

Figure 4 below highlights the impulse response functions to a tightening shock on the household Loan-to-Value (LTV) ratio. This is to illustrate the effects of a demand-side macroprudential tool specifically designed to target borrower limits.

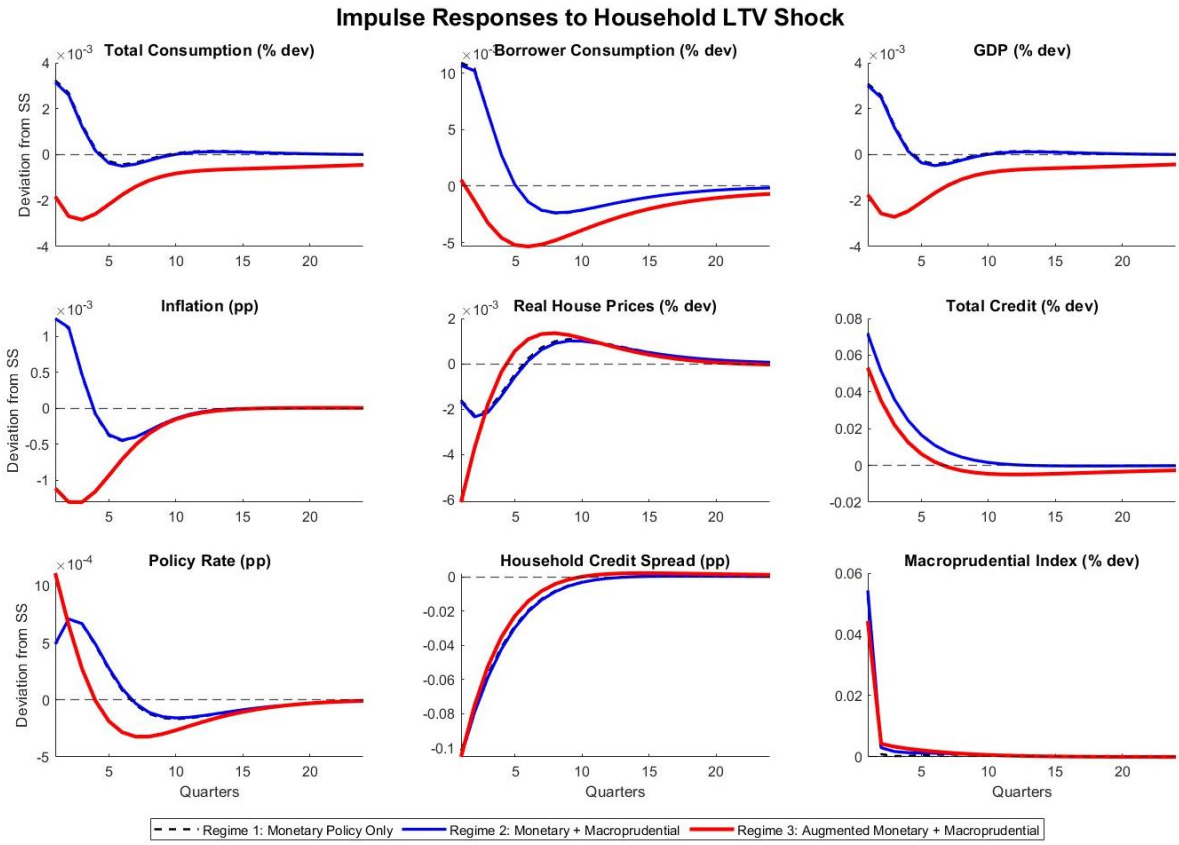


*Figure 4: Impulse responses to household LTV shock*

The impulse response functions (IRFs) in Figure 4 show the effects of tightening the household Loan-to-Value (LTV), a demand-side macroprudential tool aimed at limiting borrower leverage. The reduction in maximum LTV ratio means that the household's ability to borrow is restricted and it limits their ability or capacity to get loans to buy houses. As shown in Figure 4, this shock leads to an immediate contraction in total household borrowing, which is shown by the sharp decrease in total credit across the regimes. This decrease in credit demand has a direct impact on the housing market since it means only a smaller proportion of households can afford to finance their homes. Fewer potential buyers are able to secure financing which means the demand for housing decreases. This reinforces the role of credit availability as a driver of housing market cycles (Duca et al., 2010).

The decrease in house prices triggers a feedback loop through the financial accelerator mechanism, where lower collateral values reduce households' borrowing capacity, further deepening the

contraction in credit and asset prices (Bernanke et al., 1999). This creates a downward price cycle within the housing market, demonstrating the impact that the household LTV tools have on the core of a credit-fuelled boom. The credit spread as shown in Figure 4 initially tightened slightly as the riskiest borrowers are immediately priced out of the market, this decreases the average risk profile of the remaining people who can afford loans. Over time, the spread may widen as banks factor in broader economic risks.

The contraction in housing and credit markets spills over into the broader economy. Falling house prices reduce household wealth, leading to a decrease in total consumption. At the same time, reduced access to credit further limits consumption and investment as shown in Figure 4 above. The combined decline in demand results in a contraction in GDP and disinflationary pressure, pushing inflation below its target.

In Regime 1, the central bank lowers interest rates when inflation and output decrease, providing a counter-cyclical response. In Regime 2, the response is similar but more effective, as the economy returns to equilibrium faster. In Regime 3, the augmented monetary rule leads to more aggressive rate cuts, but it doesn't result in a quicker recovery compared to Regime 2.

The analysis of the LTV shock offers key insights for macroprudential policy design, especially in heterogeneous housing markets like South Africa. It confirms that borrower-based tools, such as LTV caps, are effective in cooling credit demand and deflating housing bubbles. It makes them a good tool for addressing financial stability risks originating from household limitations (Claessens et al., 2013).

The results also reveal a trade-off, while LTV tools are effective, they also have short-term costs which includes reduced consumption, lower output, and potential financial stress for recent homebuyers as their equity declines. This implies that macroprudential tightening, while it is good for longer-term stability, is not a free lunch. Secondly, the great performance of Regime 2 provides a good argument for a coordinated framework. It shows that the negative side effects of a macroprudential tightening can be most effectively mitigated when monetary policy is explicitly tasked with and empowered to support financial stability objectives. This coordination allows the

central bank to act as a shock absorber that eases policy to offset the demand shock caused by the regulatory tightening.

From a welfare perspective, this coordinated approach is likely superior. It protects the wider economy, including savers and people in sectors outside housing, while still achieving the goal of financial stability by reducing debt. For South African policymakers, this suggests that tools like LTV ratios should not be used in isolation. Instead, they should be part of a broader strategy, working alongside monetary policy, to ensure both price and financial stability (Svenson, 2018).

The impulse responses from Figure 5 shown below show a negative shock in the entrepreneurial Loan-to-Value (LTV) ratio show a transmission mechanism that primarily affects the supply side of the economy.

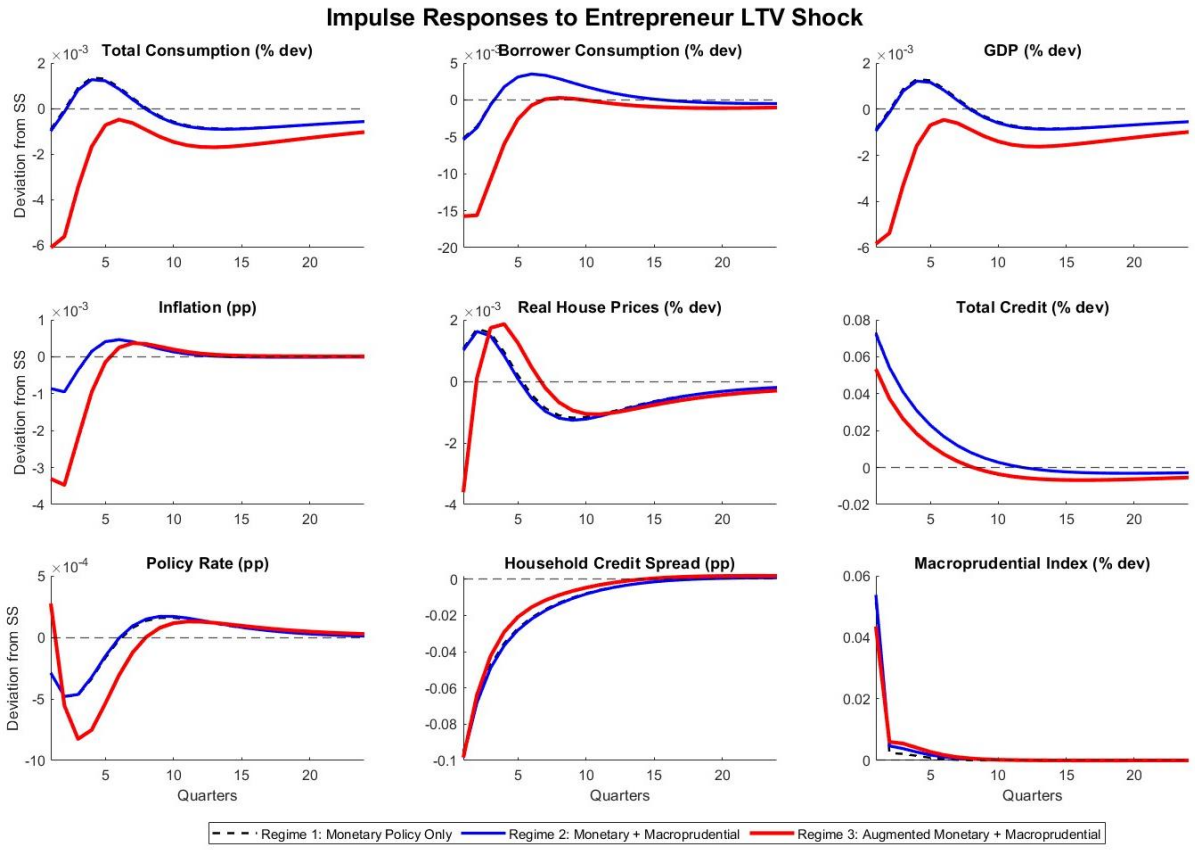


*Figure 5: Impulse responses to entrepreneur LTV shock*

The impulse responses in Figure 5 shows how key economic factors react to a negative shock in the entrepreneurial Loan-to-Value (LTV) ratio. This shock reduces entrepreneurs' ability to borrow using commercial property as collateral. It mainly affects the supply side of the economy. Unlike household LTV shocks, which usually reduce the demand for credit, this type of entrepreneurial LTV shock restricts access to financing for investment and property purchases. As a result, it causes a supply-side contraction and disrupts the production of goods and services. From the figure, the supply-side credit decrease is heightened under the monetary policy-only framework (Regime I), where no macroprudential tools are used.

This restricted credit access generates a supply shock that disrupts the production sector. Entrepreneurs respond by cutting back on investments and reducing production which leads to a GDP decline. The decrease in supply pushes prices higher, which leads to inflation increase across all policy regimes. This initial increase in inflation IRF is driven by both supply-side cost pressures and higher production costs resulting from tighter credit conditions. This is seen to be consistent with the financial accelerator mechanism, where borrowing constraints intensify the economic impact of negative shocks (Bernanke et al., 1999). A recent study further emphasize how tighter credit exacerbates inflationary pressures and reduces output (Gertler & Gilchrist, 2018).

The IRF for total consumption shows an initial increase, followed by a peak, and then a gradual decline until it stabilizes. This pattern indicates that in the short term, households adjust their spending in response to the shock, but as credit conditions tighten, borrowing becomes more expensive for entrepreneurs. Their costs of production increase meaning costs of goods and services that they produce becomes expensive. As production decreases it means the income of households decrease leading to a gradual contraction in consumption over time. The initial spike in consumption shows short-term adjustments, while the decline highlights the long-term effects of reduced access to credit. This is consistent with findings from a prior study, that shows that credit tightening for businesses leads to lower income for households, which reduces consumer spending (Mian & Sufi, 2018). Similarly, financial tightening can initially boost consumption, but over time, as borrowing capacity decreases, it leads to contraction (Bordo, 2010).

The IRF for GDP follows a similar pattern, with an initial increase, driven by short-term adjustments, followed by a sharp decline as businesses reduce investment and scale back production. This aligns with the theory of supply-side shocks where tighter credit limits business activity, leading to downward pressure on output, consistent with Claessens (2015). The IRF for inflation shows a temporary increase in prices, driven by cost-push inflation, as reduced supply increases production costs, reflecting the findings of Bernanke et al. (1999) and Borio & Zhu (2012), who show that credit tightening exacerbates inflationary pressures due to rising costs.

Credit restrictions on entrepreneurs cause household wealth to slowly decline because jobs and wages are reducing. This makes the impact of credit limits even worse for the overall economy (Christensen & Dib, 2008). Similarly, credit shocks to entrepreneurs in South Africa have been found to reduce household spending over time, especially in economies that rely a heavily on entrepreneurial activity (Dlamini & Ngalawa, 2022).

## 4.3. Policy Functions

Table 3 illustrates how different parts of the economy interact with each other over time. This shows that what happened in the past influences what happens today.

*Table 3: Policy and Transition Functions*

| | $c_s$ | $c_b$ | $c_e$ | $c_f$ | $h_s$ | $h_b$ | $h_e$ | $d$ | $y$ |
|---|---|---|---|---|---|---|---|---|---|
| $c_{s-1}$ | 0.4682 | 0.0574 | -0.0443 | 0.1003 | -0.0181 | 0.3484 | -0.0504 | 0.0116 | 0.2941 |
| $c_{b-1}$ | 0.0048 | 0.4166 | 0.0226 | -0.0444 | 0.0113 | -0.2473 | 0.0442 | -0.0495 | 0.1274 |
| $c_{e-1}$ | -0.0026 | 0.0033 | 0.4779 | -0.0114 | 0.0017 | 0.0241 | -0.0200 | -0.0104 | 0.0212 |
| $c_{f-1}$ | -0.0010 | 0.0025 | -0.0042 | 0.4814 | 0.0014 | 0.0047 | -0.0097 | -0.0094 | 0.0095 |
| $h_{s-1}$ | -0.0618 | -0.2088 | -5.2606 | -8.4025 | 2.0972 | -2.4564 | -10.4981 | -8.1010 | -0.5074 |
| $h_{b-1}$ | -0.0922 | 0.5315 | -0.7261 | 0.1641 | -0.0642 | 3.7250 | -1.2498 | 0.3796 | 0.0741 |
| $h_{e-1}$ | 0.0086 | -0.0111 | 0.0148 | -0.0327 | 0.0115 | -0.1710 | 0.0101 | -0.0411 | 0.0018 |
| ***d(-1)*** | -0.0085 | -0.0286 | -0.7217 | -1.1527 | 0.2877 | -0.3370 | -1.4402 | -1.1114 | -0.0696 |
| ***y(-1)*** | 0.0460 | 0.2326 | 0.0764 | 0.3394 | -0.0687 | 0.7478 | 0.0566 | 0.4066 | 0.1069 |

**Notes on variables:** Consumption by Savers ($c_s$), Consumption by Borrowers ($c_b$), Consumption by Entrepreneurs ($c_e$), Consumption by Firms ($c_f$), Housing Stock Savers ($h_s$), Housing Stock Borrowers ($h_b$), Housing Stock Entrepreneurs ($h_e$), Debt ($d$), Output ($y$).

The consumption coefficients reveal that borrower consumption ($c_b$) depends strongly on its own past (0.4166) and on past output (0.2326). In South Africa, where household debt-to-income ratios are among the highest in emerging markets, this persistence implies that shocks to income or credit conditions have prolonged effects on household welfare. Macroprudential policies that stabilize credit can therefore deliver substantial welfare gains by reducing the amplitude and duration of consumption fluctuations.

The housing stock coefficients reveal important cross-sectoral dynamics. Entrepreneurial housing ($h_e$) negatively affects saver housing ($h_s$) with a coefficient of -10.4981, indicating strong crowding-out effects. In the South African context, where commercial property development often competes with residential construction for land and financing, this finding has direct policy relevance. The segmented nature of South Africa's housing market with affordable, middle-income, and luxury segments exhibiting different dynamics (Das et al., 2011) means that policies affecting entrepreneurial housing investment can have spillover effects on household access to mortgage finance.

The debt persistence coefficients show strong feedback from past output to current debt, confirming the credit-driven nature of South African economic growth. Between 2000 and 2007, South Africa experienced average annual mortgage loan growth of 17%,a pattern consistent with the model's prediction that output expansions fuel credit demand (Maphosa, 2020). The COVID-19 pandemic period, during which the SARB cut the repo rate from 6.5% to 3.75%, further illustrates this relationship: cheaper credit boosted mortgage accessibility but also raised concerns about household debt sustainability (South African Reserve Bank, 2020).

The high persistence in entrepreneurial consumption reflects the longer investment cycles which are characteristic of South African firms, particularly in capital-intensive sectors such as mining

and manufacturing. This persistence suggests that entrepreneur's smooth consumption (dividends) over time, even when credit conditions change, consistent with dividend smoothing behaviour documented in South African corporate finance (Liu & Molise, 2020).

The model's high debt persistence and collateral channels reveal the economy's vulnerability to financial shocks. It explains why a regime based only on standard monetary policy (Regime I) struggles to contain financial cycles, as interest rate adjustments are typically slow and limited in their effects on financial stability. In contrast, macroprudential policy regimes (Regimes II and III), which incorporate LTV ratios and CCyB, are more effective at mitigating financial volatility. This finding is supported by cross-country evidence, where macroprudential tools have been shown to decrease systemic risks and smooth credit cycles across different economic environments (Borio, 2003; Cerutti et al., 2015).

## 4.4. Robustness Analysis

To test the sensitivity of the results, key parameters were varied within plausible ranges informed by the literature. The parameters governing the response LTV shock persistence was adjusted between 0.7 and 0.95. In all cases, the main findings held: Regime III best stabilises credit and housing markets, while Regime II delivers the most stable output and consumption. The results are therefore robust to reasonable variations in parameter values.

## 4.5. Welfare Analysis

Table 4 represents a welfare analysis, which helps to see the economic well-being of agents within the economy in response to policy changes or external shocks. This analysis provides a base for policymaking that is structured on evidence across three main policy regimes across five shocks. It follows economic principles of welfare to see how policy frameworks work to mitigate welfare impacts that come from different shocks and how welfare is distributed across heterogeneous agents. This highlights the potential trade-off that exists when different policies are applied. In this

case, welfare losses are measured as deviation from the steady state equilibrium following a shock. This would represent the position that would make economic agents indifferent between steady state conditions and a shock scenario.

*Table 4: Aggregated welfare loss (average across shocks)*

| **Variable** | **Regime 1** | **Regime 2** | **Regime 3** |
|---|---|---|---|
| Saver Consumption | 0.000142 | 0.000142 | 0.000132 |
| Borrower Consumption | 0.002244 | 0.002236 | 0.001836 |
| Output (GDP) | 0.000432 | 0.000428 | 0.000358 |
| Inflation | 0.00006 | 0.00006 | 0.000053 |
| Housing Services - Savers | 0.000423 | 0.00041 | 0.000288 |
| Housing Services - Borrowers | 0.033183 | 0.033375 | 0.023414 |
| Household Credit Spread | 0.009391 | 0.009892 | 0.008557 |
| Total Credit (or Lending) | 0.010938 | 0.010688 | 0.007061 |
| Macroprudential Index | 0.001458 | 0.001575 | 0.001114 |

Table 4 shows that Regime 3 has the strongest stabilisation across the variables and this is more pronounced for borrower consumption (0.001836 vs. 0.002244 in Regime 1), output (0.000358 vs. 0.000432), and total credit (0.007061 vs. 0.010938). These lower welfare losses mean that coordinating monetary policy (augmented Taylor rule) with macroprudential tools leads to an improvement in overall stability compared to regimes without such coordination. This finding aligns with the literature showing that combining policy instruments can better manage systemic risk and macroeconomic volatility (Angelini et al., 2011; Quint & Rabanal, 2014; Rubio & Carrasco-Gallego, 2014). However, trade-offs are present: while most variables benefit, inflation losses decrease only slightly (0.000053 in Regime 3 vs. 0.00006), and this shows the policy trade-off between price stability and real-financial sector stabilisation, this is consistent with Iacoviello's (2005) findings.

Within all regimes, savers face little and stable welfare losses (0.000132–0.000142), this shows that the depend less on credit and are more immune to shocks. On the other side, results from Table 4 show that borrowers receive even higher losses (0.001836–0.002244) and this shows their vulnerability since they heavily rely on credit and housing collateral. The difference between these two groups is that borrowers lose around 13 to 17 more in housing services which shows distributional impacts in unequal economies such as South Africa. The findings in this paper align with financial accelerator theories, where collateral-constrained agents experience amplified negative shocks (Iacoviello, 2005; Kiyotaki & Moore, 1997; Mian & Sufi, 2014). Regime 3 is a better approach since the losses that borrowers experience is much less than what they experience in Regime 1 and 2.

The findings show that policy coordination enhances does have an impact on the financial stability of a country especially when it comes to lending and credit market. Within the Regime 3, total credit losses decrease (0.007061), and household credit spreads also narrow (0.008557), while saver welfare remains largely unaffected. This shows that macroprudential measures are mostly effective for borrowers and credit-constrained households. This behaviour is consistent with studies showing that targeted interventions can reduce credit and asset market risks without negatively impacting unconstrained agents (Claessens et al., 2013; Borio & Zhu, 2012; Kannan et al., 2009). It further emphasises on that combining macroprudential policy tools with interest rate policies helps smooth credit cycles and stabilize housing booms (Angelini et al., 2014; Cerutti et al., 2015).

Welfare losses across different shock type show that housing demand shocks have a substantial effect on borrowers' housing services (0.023414 in Regime 3), this shows their high sensitivity to house price changes. On the other hand, technology shocks mostly influence output and borrower consumption (0.000358 and 0.001836) and this evidence aligns closely with New Keynesian and standard real business cycle models, where productivity gains bring improvements to welfare (Christiano et al., 2005; Del Regil, 2021; Smets & Wouters, 2007). The results suggest that Regime 3 provides the greatest stabilization for borrowers, although the magnitude of effects differs across shock types.

Although macroprudential policies mainly focus on borrowers, Regime 3 also provides small benefits for savers, by slightly lowering their welfare loss (0.000132 vs. 0.000142). This shows that coordinated policies are helpful to all economic agents by reducing systemic risk and improving overall (Gupta & Sun. 2020; Kannan et al., 2009). Overall, the results on welfare show that coordination improves welfare and reduces economic volatility in South Africa.

# Chapter Five

## 5. Conclusion

### 5.1. Summary of Findings

This study had two primary objectives: first, to examine how the coordination of monetary and macroprudential policies influences the South African economy's response to housing price shocks; and second, to assess whether such coordination generates welfare gains compared to using each instrument in isolation. It employed a Dynamic Stochastic General Equilibrium (DSGE) model featuring heterogeneous agents and a financial accelerator mechanism. The analysis evaluated three policy regimes, a baseline of monetary policy alone, a combination of monetary and macroprudential policy, and a fully coordinated framework with an augmented monetary rule. The results, derived from impulse response functions, eigenvalue stability analysis, and transition functions offer significant theoretical and practical contributions.

The primary finding of this research is that policy coordination is critical for enhancing financial stability and improving welfare outcomes, especially in emerging markets like South Africa. The impulse responses to financial shocks, specifically housing demand and LTV shocks, demonstrate that a composite macroprudential policy, combining loan-to-value (LTV) ratios and countercyclical capital buffers (CCyB), is more effective than monetary policy alone. By simultaneously restricting credit demand (via LTV) and credit supply (via CCyB), the coordinated approach in Regimes II and III successfully dampens the feedback loops of the financial accelerator, leading to a reduction in the volatility of house prices, credit growth, and overall output. This finding directly supports the theoretical predictions of Bernanke et al. (1996) and Iacoviello (2005), who demonstrate that collateral constraints amplify credit cycles. It also aligns with Dlamini and Ngalawa (2022) and Angelini et al. (2014), who document the effectiveness of macroprudential tools in curbing credit volatility.

The welfare analysis confirms that this enhanced stability translates into tangible benefits, particularly for credit-constrained borrowers who are most vulnerable to the boom-bust cycles in the housing market. This finding directly addresses the first research objective, showing that coordinated policies significantly improve the economy's resilience to housing price shocks.

While coordination proves effective for financial shocks, the study also reveals important limitations. The effectiveness of macroprudential interventions is shock-dependent. The response to a positive technology shock revealed the potential pitfalls of an overly aggressive policy approach. This result is consistent with Kannan et al. (2009) and Svensson (2017), who caution that policy rules unable to distinguish between financial and productivity shocks can lead to policy errors. In this case, the tightening of macroprudential tools in response to healthy, productivity-driven credit growth was counterproductive, unnecessarily slowing down a beneficial economic expansion. This points to a need for policymakers to differentiate between financial and productivity shocks and to adopt a discerning approach when using macroprudential tools to avoid policy errors.

The technical underpinnings of the model further validate these policy conclusions. The eigenvalue analysis confirmed the model's stability and its ability to generate realistic, dampened cycles in response to shocks, closely reflecting actual business cycle behaviour. More importantly, the transition matrix provided a microeconomic foundation for the impulse response results. It showed the self-reinforcing persistence of debt and the transmission channels through which housing collateral affects consumption and investment across different agent types. The structural connections, such as the high sensitivity of borrower consumption to past housing wealth, explain why instruments like the interest rate are insufficient and why targeted macroprudential tools are necessary to address systemic risks at their source.

## 5.2. Policy Recommendations

Based on the findings, the following policy recommendations are proposed for the South African Reserve Bank. First, the SARB should adopt a composite macroprudential index coordinating LTV

ratios and CCyB within a single framework. This coordinated approach is more effective than using either instrument alone, as it simultaneously influences credit demand and supply, dampening the financial accelerator feedback loops that amplify housing-driven credit cycles.

Second, policymakers should implement state-contingent rules that respond differently depending on the shock source. Active macroprudential policy delivers clear stabilisation benefits during housing demand shocks and credit booms. However, tightening during productivity-driven expansions unnecessarily slows growth, requiring frameworks that distinguish between financial and productivity shocks. Third, monetary policy should remain focused on price stability while strengthening institutional coordination between monetary and macroprudential functions within the SARB. Basic coordination delivers the most stable output and consumption outcomes, while deeper coordination adds value for credit and housing markets, reinforcing that macroprudential policy should bear primary responsibility for financial stability.

## 5.3. Limitations and Future Research

A key limitation is the closed-economy setup, which does not account for South Africa's links to global financial markets. While this choice helped isolate domestic policy effects, the results should be seen as showing how well policies work under controlled conditions rather than exact forecasts for the open economy. Future research could build on this work by opening the model to incorporate external shocks and cross-border financial spillovers, refining the welfare metrics to capture inequality better. Ultimately, this study shows that a well-coordinated policy approach is the best way to manage housing market volatility and reduce systemic financial risks.

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24-08-2025
Miss Arehone Matambele (225054037)
Westville

Dear Miss Arehone Matambele,

**Original application number:** 00032494
**Project title:** Monetary and macroprudential policy adopted in a model with house price booms

## Exemption from Ethics Review

In response to your application received on 15 August 2025, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW.**

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

**PLEASE NOTE:**
Research data should be securely stored in the discipline/department for

a period of 5 years. I take this opportunity of wishing you everything of

the best with your study.

Yours sincerely,

Prof Claire Lauren Vermak
Academic Leader Research

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