EFFECTS OF MONETARY AND MACRO-PRUDENTIAL POLICIES ON CREDIT AND REAL ECONOMY IN LITHUANIA

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INTRODUCTION

The interaction between monetary and macro-prudential policies plays a critical role in shaping the economic and financial landscape, particularly in small, open economies like Lithuania. This study investigates these interactions, focusing on how these policies influence credit dynamics and broader economic conditions. The significance of this research stems from the necessity to understand the combined effects of monetary and macro-prudential policies to foster financial stability and sustainable growth.

Monetary policy, especially as implemented by the European Central Bank (ECB), has profound implications for national credit markets. Holton and d'Acri (2015) highlight the significant influence of ECB interest rate decisions on lending, which is particularly relevant for Lithuania's economic context. While there is extensive research on the transmission mechanisms of monetary policy, the specific impacts of macro-prudential policies and their timing—whether during announcement or enforcement—on Lithuania's economy remain underexplored. Foundational studies by Bernanke and Gertler (1995) and Gertler and Gilchrist (1993) emphasize the importance of the credit channel in monetary policy transmission, yet a comprehensive examination of the combined effects of these policies in Lithuania is lacking.

This research aims to fill this gap by employing a Structural Vector Autoregression (SVAR) model to analyze the interactions between these policies and various credit aggregates. The SVAR model is particularly suitable for capturing the dynamic relationships among these variables over time. By distinguishing between the announcement and enforcement phases of macro-prudential policies, this study seeks to provide nuanced insights into how market expectations and actual policy implementations affect economic outcomes.

A key difference in this study is the use of a measure of the monetary policy rate that accounts for the pre- and post-adoption of the euro in Lithuania. This approach ensures that the analysis accurately reflects the monetary conditions specific to Lithuania's transition into the Eurozone. The dataset spans from 2004Q3 to 2023Q4 and includes critical economic indicators such as GDP, the Harmonized Index of Consumer Prices (HICP), and credit totals for households and non-financial corporations, along with the monetary policy rate and macro-prudential policy variables.

The research design meticulously examines the differential impacts of macro-prudential policy announcements versus their enforcement. This involves analyzing the impulse response functions and forecast error variance decompositions to understand the immediate and delayed effects of these policies on key economic variables. The findings from this study are expected to highlight the importance of clear and predictable policy communication, as well as the distinct responses of different credit sectors to policy changes.

In conclusion, this study underscores the complementary roles of monetary and macro-prudential policies in fostering economic stability and growth in Lithuania. The insights provided by this research will help policymakers better navigate the complexities of modern economic environments, ensuring

long-term stability and growth by employing strategies that leverage the strengths of both policy types, ultimately contributing to a more resilient and adaptive economic framework.

1. ANALYSIS OF SCIENTIFIC LITERATURE

Interest rates are a fundamental tool in the arsenal of economic policymakers, influencing both the availability of credit and broader economic conditions. Research shows that contractionary monetary policy typically decreases investment and consumption by raising borrowing costs, thereby slowing economic activity. This relationship is particularly important for Lithuania, a small open economy in the Eurozone. Studies by Holton and d'Acri (2015) highlight how European Central Bank (ECB) policies influence national credit markets, revealing that lower interest rates boost lending, especially to small and medium-sized enterprises (SMEs), which is critical for Lithuania's economic dynamics.

Further insights from Bernanke and Gertler (1995) and Gertler and Gilchrist (1993) illustrate the credit channel of monetary policy transmission, where higher interest rates raise borrowing costs and reduce credit availability. This mechanism is crucial for understanding the amplified effects of Eurozone monetary policies on Lithuania. Complementing this, Claessens et al. (2013), along with Cerutti et al. (2017), discuss the role of macro-prudential policies in stabilizing the financial system by curbing excessive credit growth, emphasizing the importance of these policies in mitigating risks associated with credit booms and busts.

Hoek et al. (2021) highlight the increased sensitivity of emerging markets to interest rate changes. Their study shows that rising U.S. interest rates can destabilize emerging market economies by increasing debt burdens and triggering capital outflows, leading to tighter financial conditions and potential financial crises. This underscores the need for robust financial institutions in such economies to mitigate these effects. Similarly, Stakėnas and Stasiukynaitė (2017) and Rubio and Comunale (2017) examine the transmission mechanisms of monetary policy in Lithuania, emphasizing the critical influence of ECB interest rate changes on domestic credit markets and economic performance.

Andries and Melnic (2019) provide valuable insights into the role of macro-prudential policies in Lithuania. They argue that measures like countercyclical capital buffers and sectoral risk weights can complement traditional monetary policies by addressing systemic risks and enhancing financial stability. Hristov et al. (2014) and Popov and Van Horen (2015) further elaborate on how interest rate hikes lead to credit contractions and influence banks' risk-taking behaviors, affecting credit availability across different sectors.

Recent research by Angeloni et al. (2015) investigates the effectiveness of macro-prudential measures in the Eurozone. They find that these policies can significantly reduce the procyclicality of bank lending. This is particularly relevant for Lithuania, where maintaining financial stability is paramount. Another study by Dell'Ariccia et al. (2017) examines how interest rate policies impact the risk-taking behaviors of banks. Their results show that low interest rates can lead to increased risk-taking, which has implications for credit stability in Lithuania.

Mian and Sufi (2018) explore the broader economic impacts of household debt, finding that

high levels of debt can amplify the adverse effects of interest rate hikes on consumption and economic growth. This insight is particularly relevant for Lithuania, where household debt levels have been a growing concern. Kuttner and Shim (2016) add to the conversation by analyzing the global experiences with macro-prudential policies, demonstrating their effectiveness in restraining credit growth and housing price inflation, which is critical for a balanced economic growth trajectory.

The role of international financial spillovers in shaping domestic credit conditions is another critical area of study. Rey (2015) and Miranda-Agrippino and Rey (2020) examine how global financial cycles, driven by major central banks' policies, impact small open economies like Lithuania. Their research underscores the importance of coordinated macro-prudential policies to buffer against external shocks and maintain domestic financial stability. This is particularly important given Lithuania's integration into the global financial system and its susceptibility to international market fluctuations.

Jiménez et al. (2014) highlight the importance of loan supply conditions in the transmission of monetary policy, demonstrating that changes in interest rates significantly affect bank lending behaviors. This underscores the interconnectedness of monetary policy and credit markets in Lithuania. Similarly, Akinci and Olmstead-Rumsey (2018) provide empirical evidence on the impact of macro-prudential policies on credit growth and financial stability, reinforcing the need for such measures in Lithuania's policy toolkit. Furthermore, research by Akinci and Olmstead-Rumsey (2018) supports the effectiveness of macro-prudential policies in curbing credit growth and enhancing financial stability. Their findings underscore the necessity for a comprehensive policy approach that includes both macro-prudential measures and traditional monetary policies to address the complex economic challenges faced by Lithuania. This integrated perspective is crucial for maintaining economic stability and managing the interconnected dynamics of credit markets and monetary policy.

Schularick and Taylor (2012) and Jordà et al. (2013) delve into the historical analysis of credit cycles, highlighting that credit booms are often precursors to financial crises. Their research underscores the cyclical nature of credit and the necessity for vigilant monitoring and early macro-prudential interventions. This perspective is particularly relevant for Lithuania, where rapid credit expansion could pose significant risks to financial stability. Understanding these long-term trends provides crucial historical context for current economic conditions and helps anticipate potential future risks facing Lithuania's economy.

Further studies by Alessi and Detken (2018) emphasize the importance of credit-to-GDP gaps as indicators for the implementation of countercyclical capital buffers. These studies suggest that countries with more pronounced credit cycles, such as Lithuania, benefit from proactive macro-prudential measures that help moderate credit growth and prevent the buildup of systemic risks.

The works of Gambacorta et al. (2014) provide evidence on the effectiveness of macro-prudential policies in different economic contexts. Their findings indicate that tools such as loan-to-value (LTV) and debt-to-income (DTI) ratios are particularly effective in curbing excessive credit growth and mitigating financial vulnerabilities. This is crucial for Lithuania, where household indebtedness and housing market dynamics require careful management to maintain economic stability.

Moreover, Gambacorta et al. (2014) provide a cross-country analysis of unconventional monetary policies, highlighting their effectiveness at the zero lower bound. Their findings are particularly relevant in the current economic climate, where traditional monetary policy tools may be less effective. These studies suggest that a combination of macro-prudential measures and unconventional monetary policies can be beneficial for maintaining economic stability.

Integrating these perspectives, it becomes clear that the intersection of monetary policy, credit dynamics, and macro-prudential regulations forms a complex landscape crucial for economic stability in Lithuania. Studies show that coordinated efforts in these areas can help mitigate risks associated with credit booms, ensure financial stability, and foster sustainable economic growth. In summary, the literature underscores the pivotal role of interest rates in shaping credit dynamics and broader economic conditions. The interaction between monetary policy, credit availability, and macro-prudential regulations is complex, especially for small open economies like Lithuania. A thorough understanding of these interactions is essential for formulating effective policies that foster economic stability and growth.

2. RESEARCH DESIGN

2.1 The Baseline model

In our research, we delve into the complex dynamics of macro-prudential policies, interest rate, and various credit aggregates within a structured framework provided by Structural Vector Autoregression (SVAR) models. We distinctly focus on the timing of macro-prudential policy announcements versus their actual enforcement, aiming to discern the differential impact of anticipatory effects as opposed to the tangible outcomes of policy implementation. By meticulously analyzing the shocks associated with both the announcement and enforcement phases of macro-prudential policies, we seek to understand whether market reactions are predominantly driven by expectations of policy actions or by the concrete steps taken.

Macro-prudential policies serve as essential instruments for curtailing systemic financial risk and enhancing the resilience of financial systems. Our analytical approach evaluates both immediate and delayed economic responses to shocks in these policies. We particularly investigate how such shocks spread across various economic sectors, inspecting fluctuations in pivotal indicators such as Gross Domestic Product (GDP), inflation (reflected through the Harmonized Index of Consumer Prices, HICP), interest rates and most importantly - credit. The dual incorporation of announcement and enforcement timelines in our models sheds light on the effectiveness and precision of these regulatory measures.

The initial phase of our model adopts an aggregate perspective, concentrating on total credit dynamics within the economy. This broad approach enables an encompassing evaluation of the credit market's responsiveness to shifts in monetary policy, exemplified by changes in the AVIBOR interest rate, and macro-prudential adjustments. We further refine our analysis by segregating the credit data into two distinct categories: credit extended to households and credit provided to firms, each of which bears significant implications:

- **Household Credit**: The responsiveness of household credit to policy shocks is crucial, as it directly influences consumer spending capacities through mechanisms such as mortgage, car, and personal loan rates.

- **Firm Credit**: The availability of credit to firms is integral to business expansion and investment. By examining how firm credit reacts to variations in macro-prudential and monetary policies, we can infer broader economic impacts concerning investment trends, employment, and productivity enhancements.

The distinctions we draw between different types of credit and the specific timing of policy effects are pivotal in addressing intricate questions about the transmission mechanisms of these policies and their varied impacts across the economic spectrum. These insights are crucial for policymakers tasked

with formulating targeted, effective macro-prudential regulations. Simultaneously, our findings enrich the academic discourse regarding the role of anticipatory effects in economic decision-making. This expanded narrative situates our work within the broader economic context and paves the way for a comprehensive exploration of the interrelations between monetary policy and macro-prudential policy instruments.

2.2 Methodology

In our analysis, we employ a Structural Vector Autoregression (SVAR) model. The choice of a Vector Autoregression (VAR) type model stems from its ability to capture the dynamic relationships among multiple time series variables. Unlike unidirectional models like AR, ARMA, or ARIMA, a VAR model allows each variable to be a function of its own lagged values and the lagged values of all other variables in the system. This bi-directional relationship is essential when variables are thought to influence each other simultaneously, which is often the case in macroeconomic time series data.

The reduced-form VAR model can be represented by the following equation:

$$\mathbf{Y}_t = \phi_1 \mathbf{Y}_{t-1} + \phi_2 \mathbf{Y}_{t-2} + \cdots + \phi_p \mathbf{Y}_{t-p} + \mathbf{u}_t \tag{1}$$

where $\mathbf{Y}_t$ is an $n \times 1$ vector of endogenous variables at time t. The matrices ϕ_i $(i = 1, 2, \ldots, p)$ are $n \times n$ coefficient matrices corresponding to each lag i, and $\mathbf{u}_t$ is an $n \times 1$ vector of error terms (white noise).

Selecting the appropriate lag order p is crucial for the accuracy of the VAR model. The lag order is determined using information criteria such as the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (BIC), and the Hannan-Quinn Criterion (HQ). These criteria are computed for different lag lengths, and the optimal lag order is the one that minimizes these criteria. For our model, a lag order of 2 was found to be optimal based on these criteria.

To validate the adequacy of the VAR models, we performed serial correlation tests using the Portmanteau test. This test helps ensure that the residuals of the VAR models do not exhibit serial correlation, which would violate the assumptions of the VAR framework and potentially bias the results.

Once the reduced-form VAR is estimated, the next step involves identifying the structural shocks by specifying a structural form that accounts for contemporaneous interactions among the variables.

The structural VAR model can be represented as:

$$\mathbf{B}\mathbf{Y}_t = \mathbf{C}_1 \mathbf{Y}_{t-1} + \mathbf{C}_2 \mathbf{Y}_{t-2} + \cdots + \mathbf{C}_p \mathbf{Y}_{t-p} + \varepsilon_t \tag{2}$$

where $\mathbf{B}$ is an $n \times n$ matrix representing the contemporaneous relationships between the variables, and ε_t is an $n \times 1$ vector of structural shocks. To identify the shocks, we impose restrictions on the matrix

B. The approach we use for this is the Cholesky decomposition, which imposes a recursive structure on the variables. The order of variables is critical as it reflects the assumed causal relationships among them.

Cholesky decomposition is a method used to decompose a positive-definite matrix into a product of a lower triangular matrix and its transpose. In the context of SVAR models, we apply the Cholesky decomposition to the covariance matrix of the reduced-form residuals, σ_u. This decomposition allows us to transform the reduced-form residuals into orthogonal structural shocks.

Formally, the covariance matrix σ_u of the reduced-form residuals can be decomposed as:

$$\sigma_u = \mathbf{A}\mathbf{A}^T \tag{3}$$

where $\mathbf{A}$ is a lower triangular matrix obtained from the Cholesky decomposition. The matrix $\mathbf{A}$ represents the contemporaneous relationships among the variables and allows us to identify the structural shocks ε_t as:

$$\varepsilon_t = \mathbf{A}^{-1}\mathbf{u}_t \tag{4}$$

where $\mathbf{u}_t$ are the reduced-form residuals. By imposing a recursive ordering on the variables, the Cholesky decomposition assumes that each variable can be contemporaneously affected by the variables ordered before it but not by those ordered after it.

For instance, if we have three variables ordered as $\mathbf{Y}_t = [Y_{1,t}, Y_{2,t}, Y_{3,t}]'$, the Cholesky decomposition implies that $Y_{1,t}$ can affect $Y_{2,t}$ and $Y_{3,t}$ contemporaneously, $Y_{2,t}$ can affect $Y_{3,t}$ but not $Y_{1,t}$, and $Y_{3,t}$ cannot affect $Y_{1,t}$ or $Y_{2,t}$ within the same period. This hierarchical ordering reflects the assumed causal relationships and is crucial for identifying the structural shocks.

The Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) are essential tools in the analysis of VAR and SVAR models. They allow us to examine the dynamic effects of shocks on the variables in the system and understand the contribution of each shock to the forecast error variance of each variable.

The IRF traces the effect of a one-time shock to one of the variables on the current and future values of the endogenous variables. Mathematically, the IRF at horizon h is given by:

$$\mathbf{IRF}(h) = \phi^h \mathbf{B}^{-1}\varepsilon_t \tag{5}$$

where ϕ^h is the matrix of coefficients that describes how the shock propagates through the system over time.

The FEVD provides the proportion of the forecast error variance of an endogenous variable that is attributable to orthogonalized shocks to each endogenous variable. For a given horizon h, the

FEVD for variable i due to shock j is given by:

$$\text{FEVD}_{i,j}(h) = \frac{\sum_{k=0}^{h-1}(\mathbf{e}_j'\phi^k\mathbf{B}^{-1}\varepsilon_t)^2}{\sum_{j=1}^{n}\sum_{k=0}^{h-1}(\mathbf{e}_j'\phi^k\mathbf{B}^{-1}\varepsilon_t)^2} \tag{6}$$

where $\mathbf{e}_j$ is a selection vector that isolates the effect of the j-th shock.

In our model, the sequencing of these variables is meticulously considered. Following Kim and Mehrotra (2018) and Kim and Mehrotra (2022), we postulate that the initial three variables—RGDP, HICP, and credit totals—are contemporaneously exogenous in relation to the macro-prudential and AVIBOR variables. This arrangement permits the analysis of delayed responses to policy shifts, thereby isolating the immediate effects of shocks to the macro-prudential or monetary policies. A logarithmic difference transformation is applied for real GDP, HICP, real credit, and AVIBOR, and then multiplied by 100.

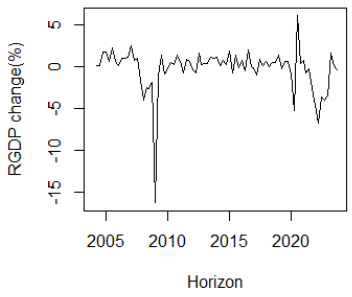
2.3 Description of Data

To evaluate the macroeconomic impacts of various policy instruments, I have employed a comprehensive dataset that includes time-series data collected from 2004Q3 to 2023Q4, sourced from organizations such as the Bank of Lithuania, the Official Statistics portal overseen by the Lietuvos Respublikos Vyriausybe (Valstybes duomenu agentura), Federal Reserve Economic Data (FRED), and the European Central Bank. The table with the variable sources can be seen in Appendix Table 1. The dataset incorporates several key variables: Gross Domestic Product (GDP), Harmonized Index of Consumer Prices (HICP), outstanding credit totals for households and non-financial corporations and the AVIBOR rate, as well as an index representing macro-prudential policies. The transformed variables we use in our analysis can be seen in Fig.1.

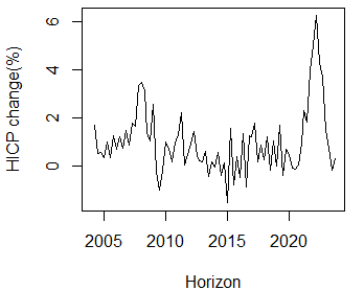
Gross Domestic Product (GDP) is the primary indicator of a nation's economic health, representing the total value of all goods and services produced. Including GDP in our study helps us evaluate both the overall economic situation and the immediate effects of monetary and macro-prudential policies. According to Cross (2016), various approaches to understanding GDP provide essential insights for making policy decisions, especially in changing economic conditions.

The Harmonized Index of Consumer Prices (HICP) is a crucial tool for tracking inflation, capturing price fluctuations of goods and services within the economy. It utilizes weighted averages to represent spending across diverse categories, offering a detailed view of inflation trends. In our study, HICP is employed to adjust nominal figures such as GDP and credit, distinguishing real economic shifts from inflationary effects. This differentiation ensures that observed changes in these indicators accurately reflect actual volume changes, not simply price movements. Moreover, HICP provides insights into inflation patterns in Lithuania, reflecting alterations in consumer purchasing power.

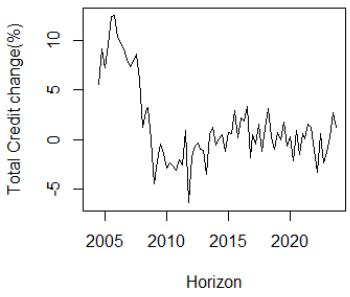
Credit serves as a fundamental mechanism through which monetary policy influences the economy, with central banks' interest rate adjustments directly affecting borrowing costs. This dynamic



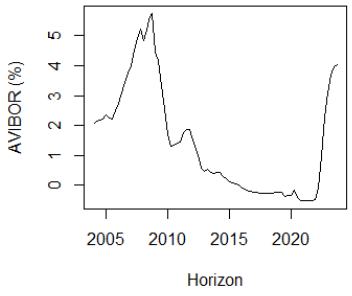
(a) RGDP change (%)



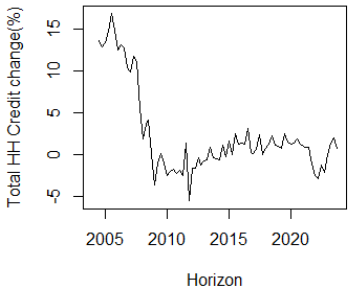
(b) HICP change (%)



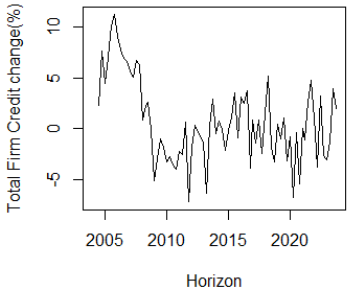
(c) Total Credit change (%)



(d) AVIBOR change (%)



(e) Household Credit change (%)



(f) Firm Credit change (%)

Figure 1
Variables used in the analysis excluding Macro-prudential policy variables

shapes the propensity and capacity of consumers and businesses to acquire credit, which in turn influences economic stability and growth. Notably linked to domestic financial resources relative to GDP, credit is pivotal in our structural vector autoregression (SVAR) model. The studies by Hedlund (2018) and Igan et al. (2009) demonstrate how credit constraints amplify house price dynamics and how credit growth often precedes and predicts financial instabilities, reinforcing the need for careful monitoring and regulation. These interactions suggest that credit is not merely a reflection of economic conditions but a central component that shapes economic landscapes, especially in critical sectors such as housing.

In our structural vector autoregression (SVAR) model, we include a macro-prudential policy variable to capture the regulatory measures aimed at maintaining financial stability and mitigating systemic risk. Macro-prudential policies involve adjusting regulations to ensure financial system stability and resilience. These policies include setting capital requirements to help banks absorb losses, limiting loan-to-value ratios to prevent excessive borrowing, and implementing countercyclical capital buffers to smooth out economic cycles. Other measures include liquidity requirements to prevent bank

runs, debt-to-income ratios to curb excessive borrowing, and stress testing to assess banks' resilience to economic shocks.

To quantify this variable, we assign a value of +1 for each policy tightening action and -1 for each policy loosening action. This binary scoring approach allows us to create a cumulative index over time, which reflects the overall stance of macro-prudential policy. This cumulative index is integrated into our SVAR model to examine how changes in macro-prudential policy influence key economic variables.

There are two versions of the macro-prudential policy variable. One version assigns +1 or -1 based on when a macro-prudential policy is announced, capturing the market's initial reaction to regulatory changes. The other version uses the same scoring system but applies it when the previously announced policies go into effect, reflecting the actual implementation and its immediate impact on the financial system.

The simplicity of our scoring method effectively captures the directional intensity of macro-prudential efforts, allowing us to trace their effects on the economy. Empirical evidence, such as studies by Ma (2020) and Andries and Melnic (2019), supports the significance of these policies in promoting economic growth and reducing the probability of financial crises by addressing cyclical risks in the financial system.

Lastly, in our structural vector autoregression (SVAR) model, the AVIBOR serves as a key metric, blending Euribor and Vilibor to effectively gauge monetary policy changes in Lithuania. AVIBOR is a weighted average of these two rates: VILIBOR, representing the interbank lending interest rate in Lithuanian for loans given out in Litas, and EURIBOR, representing the interbank lending interest rate in Euros. This combination provides a comprehensive measure reflecting the overall interbank lending conditions in Lithuania prior to 2015 when Lithuania adopted the euro.

This interest rate captures the shifts in monetary strategy, which directly influences borrowing and lending behaviors across the economy. For example, a reduction in AVIBOR, as part of an expansionary monetary policy, encourages increased borrowing by reducing interest costs, aiming to stimulate economic activity. Conversely, an increase in AVIBOR suggests a contractionary approach, increasing the cost of credit and potentially dampening economic dynamics. The role of inter-bank rate as both a measure and influencer of economic trends is well-articulated in the works of Stakėnas and Stasiukynaitė (2017), who explore the broader impacts of monetary shifts on Lithuania's economy, and Rubio and Comunale (2017), who analyze the transmission mechanisms of monetary policy within a two-country setting involving Lithuania and the euro area. Important to note that these studies incorporated only the EURIBOR into their models.

3. RESULTS

3.1 Impulse response

In this section I will be presenting the results from the impulse response function. It is a tool used in time series analysis to describe how a system responds to a shock over time. Specifically, it measures the reaction of variables in a dynamic system when one of the variables experiences a sudden change. I identify 3 separate shocks - a shock to announcement of macro-prudential policy, a shock to enforcement of macro-prudential policy and a shock to interest rate (AVIBOR). These shocks are a size of 1. Meaning a shock to macro-prudential policy means either an announcement or the enforcement of tightening macro-prudential policy, depending on the variable. The shock to AVIBOR means a 1 percent increase in the interest rate.

The responses of the other variables, since all other variables are measured in percentage change, are measured as such. We look at 6 different models. In these models all variables stay the same except for two - macro-prudential policy and credit. There are three versions of credit, which are credit provided to households, credit provided to firms and total credit, which is the sum of the previous two. For the former 3 models we have 3 more models in which we only replace the announcement of macro-prudential policy with the enforcement of the policy.

To reiterate, in every instance of the impulse response function, we only shock one variable - either the variable for macro-prudential policy or the interest rate.

3.2 Impulse response function with Total Credit

In Fig. 2a, we observe the impulse response functions of the variables to a shock in the macro-prudential policy announcement variable. A positive shock, interpreted as an announcement of tightening macro-prudential policy, negatively affects our monetary policy rate, which declines by around 0.2%. However, this effect is not statistically significant at the 90% confidence level. The effect on total credit is also not significant, but shows a decline of approximately 0.9%.

In Fig.2b we compare the effects when replacing the announcement of macro-prudential policy with its enforcement in our SVAR model. The figure shows how variables react to a shock to the macro-prudential policy enforcement variable. Compared to Fig.2a, the reactions of other variables are less volatile. This may support the findings of Born et al. (2012)), who argue that central banks should communicate policy changes clearly and predictably to enhance the effectiveness of macro-prudential policies and ensure accountability. It is important to note that these results are also not statistically significant at the 90% confidence level.

Initially, the impact of tightening macro-prudential policy on AVIBOR is similar for both the announcement and the enforcement of macro-prudential policy, with declines of around 0.2% and 0.1%, respectively. However, as the rate increases, we see that for the announcement, the rate reaches

the 0.0% change level and stabilizes, while for the enforcement, the rate increases to about 0.1% and remains there for the entire horizon. Although these results are not statistically significant, they suggest that market reactions to policy announcements are more volatile then to the enforcement, since the enforcement is anticipated and thus less reactive. Additionally, the fact that post macro-prudential policy enforcement shock, the AVIBOR stays at 0.1% indicates the effectiveness of tightening macro-prudential policy.

Total credit declines by around 0.9% after the announcement, but only by about 0.1% when the policy is enforced. Claessens et al. (2013) suggest that macro-prudential measures, particularly those targeting borrowers, such as caps on debt-to-income and loan-to-value ratios, effectively reduce asset and liability growth during booms. These findings imply that markets adjust their behaviors in anticipation of policy effects, demonstrating a sensitivity to the announcements themselves.

Fig. 2c presents the impulse response functions following a positive shock to the monetary policy rate. Notably, the Harmonized Index of Consumer Prices (HICP) reacts negatively, declining by about 1% in a statistically significant manner. The HICP oscillates around this level for three periods before gradually returning to zero. Interestingly, total credit mirrors the movement of HICP, although reaction of credit is not statistically significant. This relationship is supported by economic literature suggesting that lower inflation or deflationary expectations lead to reduced consumer spending, especially on durable goods, as households may delay purchases anticipating further price drops Hori and Shimizutani (2005). Additionally, research indicates that consumers respond less vigorously to deflation than to inflation Stanisławska (2019), potentially explaining the increase in total credit. Despite higher real incomes due to lower inflation, consumers might prefer to borrow, possibly for investments or asset purchases, instead of increasing their spending. Following the monetary policy shock, we also observe a gradual decline of the macro-prudential policy variable towards the -1 mark.

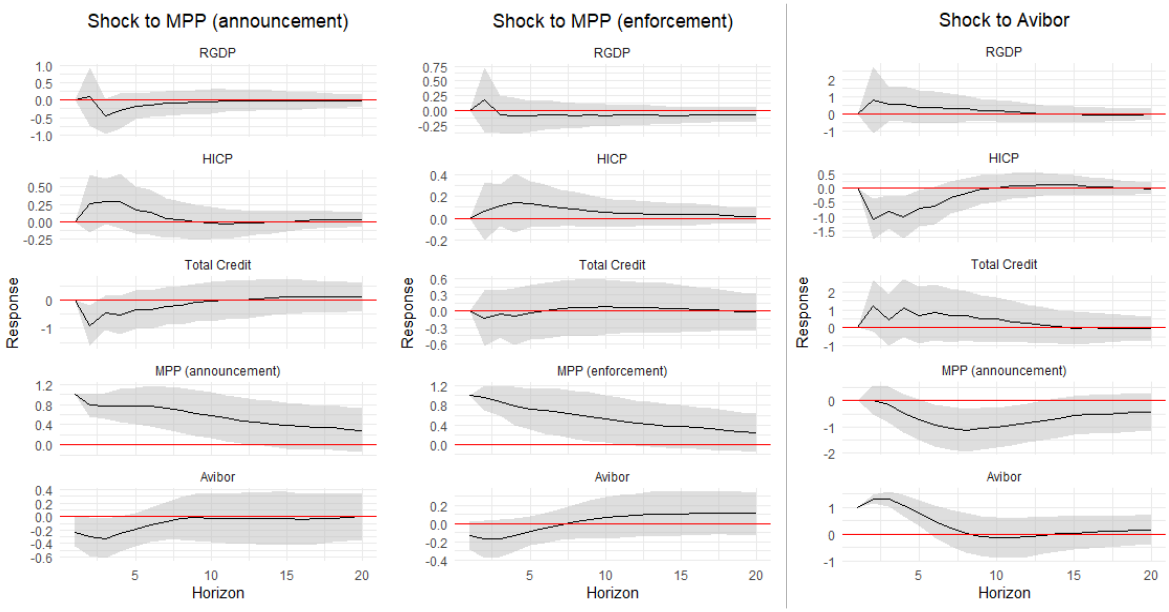


Figure 2
Impulse response functions with total credit.

Note: Plot (a) shows the impulse response function of a positive shock to macro-prudential policy announcement. Plot (b) shows the impulse response function of a positive shock to macro-prudential policy enforcement. Plot (c) shows the impulse response function of a positive shock to the monetary policy rate.

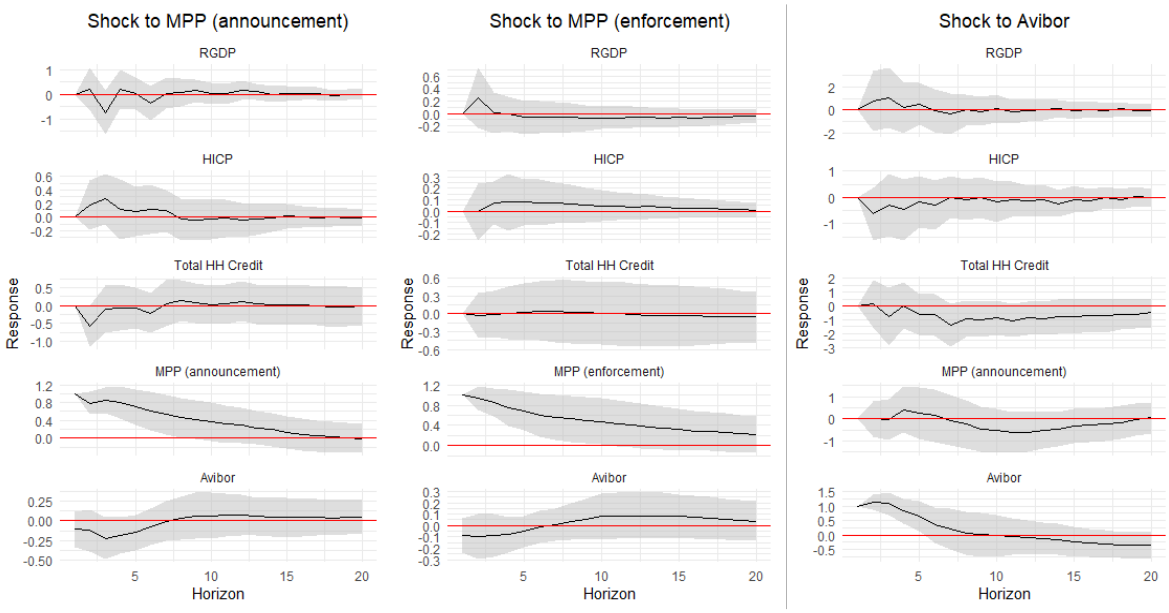
3.3 Impulse response function with Household Credit

Continuing with our analysis, we now turn to a version of the SVAR model, which replaces total credit with credit exclusively issued to households. Fig. 3a shows how this model reacts to a positive macro-prudential policy announcement shock. Comparing it with our original model some differences can be noticed. First, we notice that the effect on GDP in this version of the model is much more volatile and severe, although this effect is not statistically significant at the 90% confidence level. According to the OECD, households' final consumption contributes around 60% to the total value of GDP. It is therefore not surprising that when a shock negatively affects household credit, GDP declines by around 1%, compared to non-isolated credit, where a this shock affects the GDP by only around -0.5%. Another difference is how the credit itself reacts. In this figure, we see that due to a tightening macro-prudential policy announcement shock, the household credit changes by approximately -0.6% which is different from the -0.9% change when we look at total credit. This finding hints at the fact that it may not be the households that are the most sensitive to announcements of tightening macro-prudential policy.

Looking at Fig. 3c we can come back to our discussion on how deflation positively affects credit. Here we again see a negative effect on the HICP although it is not as severe, only moving

around -0.6 percent, which is only half of the effect in percentage terms we observed in the original model with total credit. As we discussed earlier with our original model with total credit, we saw an increase in credit of around 1.3% after a positive interest rate shock. However with only household credit included, we see an opposite reaction. At the lowest point, we observe around a -1.5% change in household credit. This again hints at the fact, that the previously observed results might not be due to the reactions of households to an increase in interest rates.

In Fig. 3b, same as with the model with total credit included, we look at how the model with household credit reacts differently when the macro-prudential policy announcement variable is replaced with the enforcement version of the variable. When we simulate a shock to the macro-prudential variable, what we observe is that all variables' reactions are minuscule. Most notable reaction is that of the interest rate which, as we have observed earlier with enforcement of macro-prudential policy, increases by around 0.1 percent. Comparing to the results in the original model, we see that results are not much different and in fact are almost identical to those in the model, which include total credit. And as we saw earlier, those results were not too telling and in fact, may strengthen our theory, that the economy is much more sensitive to the announcement of policy changes, than to the policies themselves. The positive change in the interest rate provides more evidence that our model is able to capture the effectiveness of macro-prudential policy, even if the results are not statistically significant at the 90% confidence level.



(a) **(b)** **(c)**

Figure 3

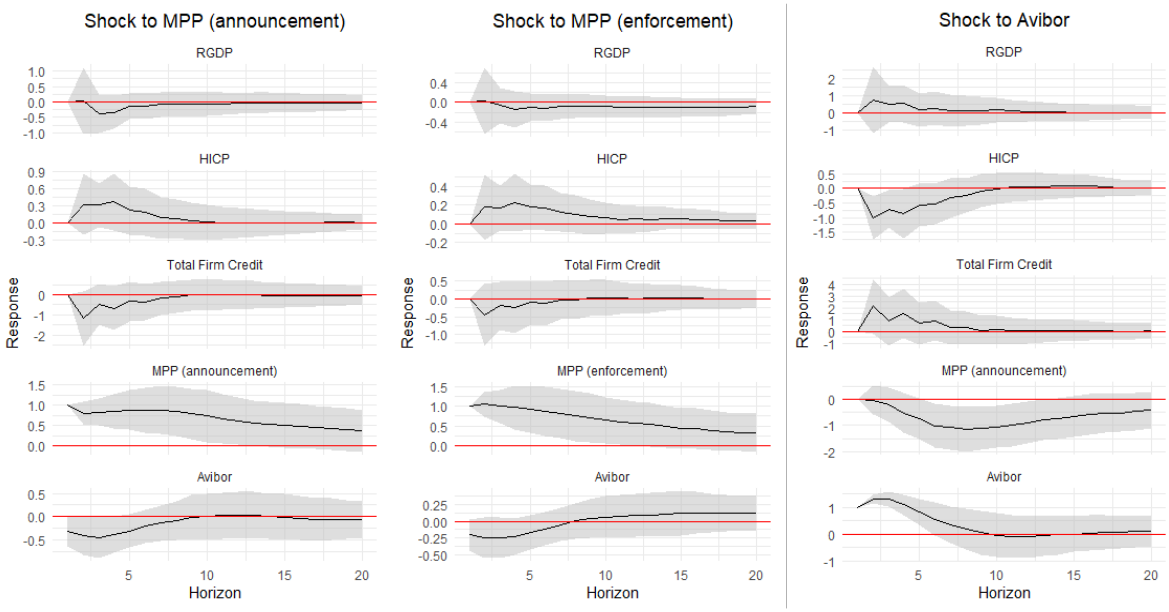
Impulse response functions with household credit. Plot (a) shows the impulse response function of a positive shock to Macro-prudential policy announcement. Plot (b) shows the impulse response function of a positive shock to interest rate. Plot (c) shows the impulse response function of a positive shock to a third variable.

3.4 Impulse response function with Firm Credit

Lastly, we examine the results of the model with the credit variable representing credit exclusively provided to non-financial firms. Fig. 4a shows how this model reacts to a tightening macro-prudential policy announcement. What we see is that these results closely follow those of the original model with total credit. Comparing to the results of household credit, we see that credit of firms is much more reactive to the macro-prudential policy announcement shock. Firm credit declines by a little over 1%, compared to household credit which falls by approximately 0.6%. What we also notice is that the change of firm credit stays negative for much longer than household credit. This differential impact is supported by Lorenčič et al. (2023), who found that tightening of macro-prudential policy measures significantly reduces the growth rate of non-financial corporate sector credit, while the effect on household credit is not statistically significant. Although in our results, both models show results that are not statistically significant, this paper give some validity to our findings.

Fig. 4c shows how this model, which incorporates firm credit, reacts to an increase in the interest rate. The first thing we notice is that the GDP reaction is more mild, increasing by about 0.8% than compared to the model with household credit, where GDP increased by a little over 1%. These results are also not statistically significant at the 90% confidence interval. Another difference is that the HICP decline is harsher, falling by about 1 percent, while with household credit, this change was only about -0.6 percent. Like previously, these results are in fact statistically significant. Most interesting of the results is the reaction of firm credit. Due to a positive shock to the interest rate, the firms' borrowing increased by a little over 2%. Comparing to the results of the model with household credit, where credit almost immediately declined and fell by 1.5%, we see an interesting effect where a positive shock to the interest rate causes households to limit their borrowing, while firms do the opposite and increase their credit. These results may indicate that when households are not able to borrow, firms may receive more favorable loan conditions to maintain bank profitability, however this claim would need an in-depth study of it's own.

In Fig. 4b, like we did with the models with total and household credit, we examine the response of the model when the macro-prudential policy enforcement variable replaces the announcement. Upon simulating a shock to the macro-prudential policy enforcement variable, we observe that the reactions of most variables are relatively small. The most noticeable response is from the interest rate, which increases by approximately 0.1 percent. This mirrors the response we observed previously with the enforcement of macro-prudential policy. Comparing these results to the original model, we find that the outcomes are quite similar and nearly identical to those in the model that includes total credit. This further supports our theory that the economy is more sensitive to the announcement of policy changes than to the policies themselves. The slight positive change in the interest rate continues to indicate that our model can capture the effects of macro-prudential policy, although these results are not statistically significant at the 90% confidence level.



(a) **(b)** **(c)**

Figure 4

Impulse response functions with Firm credit. Plot (a) shows the impulse response function of a positive shock to Macro-prudential policy announcement. Plot (b) shows the impulse response function of a positive shock to interest rate. Plot (c) shows the impulse response function of a positive shock to a third variable.

3.5 Forecast Error Variance Decomposition

In this section we discuss the findings from the forecast error variance decomposition (FEVD) of our models. The FEVD allows us analyze how much of the error of each variable in a model can be explained by shocks to itself and to other variables in the model. It helps us understand which variables have a big impact on others over time, making it clearer how different economic factors interact and influence each other. This is particularly useful in our analysis since we are trying to figure out the effects of policy changes on credit and the broader economic landscape.

3.6 Forecast Error Variance Decomposition with Total Credit

Comparing the FEVD results from Fig.5a and Fig.5b of the SVAR model, we observe how differently the variables react with the announcement of macro-prudential policy compared with the enforcement.

Firstly, regarding real GDP, both figures show that the model explains only a small portion of its variance. However, in Fig.5b, the enforcement of the macro-prudential policy increases the influence of HICP and reduces the influence of AVIBOR compared to the announcement of the policy in Fig.5a.

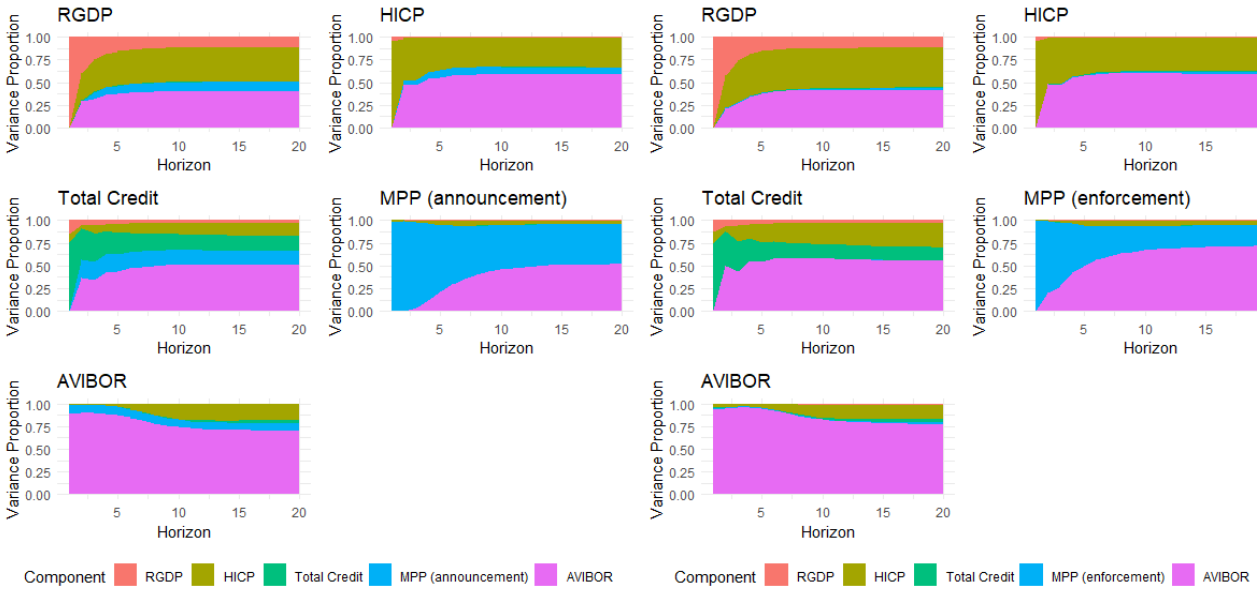
For HICP, both figures indicate almost total self-influence in the beginning, but this quickly

changes as the effect of monetary policy rate increases it's influence up to 50% in both Fig.5a and 5b.

The total credit panels in both models show that the monetary policy rate has a high influence of around 50% in both cases. Additionally, the self influence of credit quickly diminishes over a few periods from 75% to around 20% in both cases. We also see that only the macro-prudential policy announcement has a visible effect on total credit of around 12%.

In Fig.5a, the macro-prudential policy announcement variance starts of being mostly self-influenced, however it decreases over time with increasing influence from monetary policy rate reaching around 50% over the long-term. In Fig.5b this effect is even more sudden and severe indicating that the macro-prudential policy decisions are in large due to changes in the monetary policy rate changes.

The error variance of monetary policy rate is also mainly self-influenced.



(a) FEVD with total credit and announcement of macro-prudential policy

(b) FEVD with total credit and enforcement of macro-prudential policy

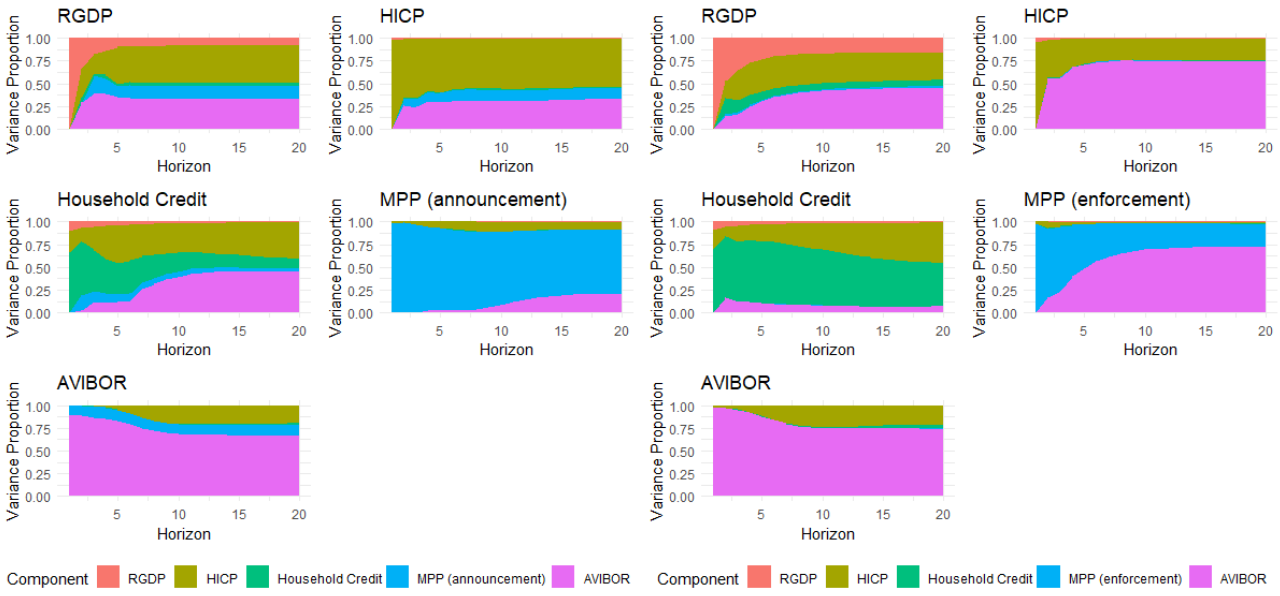
Figure 5
Comparison of FEVD with different macro-prudential policies

3.7 Forecast Error Variance Decomposition with Household Credit

Comparing the FEVD results from Fig.6a and Fig.6b, we observe several key differences and similarities in how household credit and macro-prudential policy announcement and enforcement impact the variance of the model's variables compared with total credit.

In Fig.6a, the self-influence of HICP is a lot more apparent, accounting for more than 50% of it's own variance, while in Fig.6b, the effect of monetary policy rate increases significantly, reaching almost 75% of the error variance.

In Fig. 6a, the panel for household credit reveals that upwards of 37% of its error variance can be explained by changes in HICP, indicating a strong link between inflation and household borrowing behavior. The self-influence of household credit diminishes after 6 periods, while the effect of monetary policy rate increases reaching approximately 40%. Conversely, with the macro-prudential policy enforcement, household credit becomes much more self-influenced, explaining more than half of the error variance, while the effect of monetary policy rate diminishes significantly.



(a) FEVD with household credit and announcement of macro-prudential policy

(b) FEVD with household credit and enforcement of macro-prudential policy

Figure 6

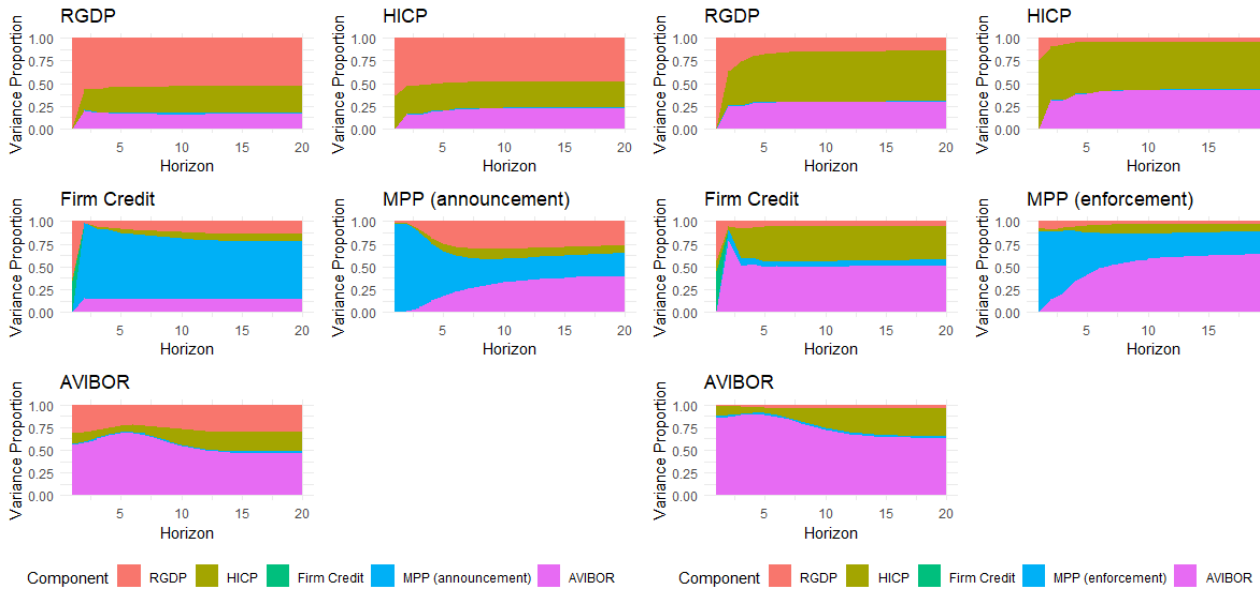
Comparison of FEVD with different macro-prudential policies for household credit

3.8 Forecast Error Variance Decomposition with Firm Credit

In Fig. 7a real GDP, unlike with other models, is highly self influenced accounting for more than 50% of the variance. Firm credit shows a minimal effect on RGDP, explaining only about 0.5% of its error variance. This indicates that firm credit's direct impact on RGDP is relatively insignificant.

Another difference we observe is that with the announcement of macro-prudential policy, HICP is also highly influenced by real GDP which is responsible for around 50% of the error variance. Compared with the enforcement of macro-prudential policy in Fig.7b, real GDP has close to no effect on the error variance of HICP.

Looking at the panels for firm credit, results show that announcement of macro-prudential policy has an unusually large effect on the error variance. It is responsible for more than 60% of the error variance while the enforcement of macro-prudential policy has a very minimal impact on firm credit variance. Here in Fig.7b results also show, that monetary policy rate has a strong influence on firm credit.



(a) FEVD with firm credit and announcement of macro-prudential policy

(b) FEVD with firm credit and enforcement of macro-prudential policy

Figure 7
Comparison of FEVD with different macro-prudential policies for firm credit

4. CONCLUSIONS

This study investigated the impact of monetary and macro-prudential policies on credit and the real economy in Lithuania using a Structural Vector Autoregression model. The results indicate that the Lithuanian economy exhibits a more pronounced reaction to macro-prudential policy announcements compared to their enforcement, highlighting the necessity for clear and predictable communication from policymakers. The analysis of credit dynamics shows that firm credit is more responsive to policy changes than household credit, underscoring the need for targeted measures to address distinct market segments.

Monetary policy shocks significantly influence inflation and credit, demonstrating the effective transmission of monetary policy. The research emphasizes the role of macro-prudential policies in controlling credit growth and enhancing financial stability. The interconnectedness of inflation, interest rates, and credit markets is further highlighted by the Forecast Error Variance Decomposition analysis.

In conclusion, this study highlights the complementary roles of monetary and macro-prudential policies in fostering economic stability and sustainable growth in Lithuania. The distinct but interrelated impacts of these policies suggest that an integrated approach, which leverages the strengths of both policy types, can more effectively address the complex dynamics of modern economies. Policymakers should consider the trade-offs and synergies between these policies to optimize their overall effectiveness. By understanding the unique contributions and limitations of each policy type, a more resilient and adaptive economic framework can be developed, ensuring long-term stability and growth.

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EFFECTS OF MONETARY AND MACRO-PRUDENTIAL POLICIES ON CREDIT AND REAL ECONOMY IN LITHUANIA

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Bachelor thesis

Quantitative Economics

Faculty of Economics and Business Administration of Vilnius University

Supervisor - Dr. Ieva Mikaliūnaitė-Jouvanceau

Vilnius, May 21, 2024

Summary

This research examines the interplay between monetary and macro-prudential policies in Lithuania and their impacts on credit dynamics and the broader economy. Employing a Structural Vector Autoregression (SVAR) model, we analyze data from 2004Q3 to 2023Q4, including real GDP, HICP (Harmonized Index of Consumer Prices), household and firm credit, the monetary policy rate, and macro-prudential policy variables. The study differentiates between the announcement and enforcement phases of macro-prudential policies. Our findings uncover that monetary policy notably influences inflation and credit, demonstrating effective transmission mechanisms, while the economy is more responsive to the announcements of macro-prudential policies than to their enforcement. Additionally, household and firm credits exhibit distinct reactions to policy changes. Impulse response functions indicate that tightening macro-prudential policies reduce total credit, while positive shocks to the monetary policy rate enhance total credit. Forecast error variance decomposition underscores the interdependencies among inflation, interest rates, and credit markets, offering insights into the influences of these variables. This research underscores the critical need for transparent policy communication and a coordinated strategy that harnesses both monetary and macro-prudential measures to drive economic stability and growth.

PINIGŲ IR MAKROPRUDENCINĖS POLITIKOS POVEIKIAI KREDITUI IR REALIAJAI EKONOMIKAI LIETUVOJE

SIMONAS ŪKSAS

Bakalauro baigiamasis darbas

Kiekybines ekonomikos programa

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Vilnius, May 21, 2024

Santrauka

Šiame tyrime nagrinėjama pinigų ir makroprudencinės politikos sąveika Lietuvoje ir jų poveikis kreditų dinamikai bei platesnei ekonomikai. Taikydami struktūrinės vektorinės autoregresijos (SVAR) modelį, analizuojame 2004 m. III ketv. - 2023 m. IV ketv. duomenis, įskaitant realųjį BVP, SVKI (suderintas vartotojų kainų indeksas), namų ūkių ir įmonių kreditus, pinigų politikos palūkanų normą ir makroprudencinės politikos kintamuosius. Tyrime skiriami makroprudencinės politikos skelbimo ir vykdymo etapai. Mūsų išvados rodo, kad pinigų politika daro didelį poveikį infliacijai ir kreditui, kas rodo veiksmingus pinigų politikos perdavimo mechanizmus, tuo tarpu ekonomika labiau reaguoja į makroprudencinės politikos paskelbimą nei į jos vykdymą. Be to, namų ūkių ir įmonių kreditai skirtingai reaguoja į politikos pokyčius. Impulsinio atsako funkcijos rodo, kad griežtėjanti makroprudencinė politika mažina bendrąjį kreditą, o teigiami pinigų politikos normos šokai didina bendrąjį kreditą. Prognozių paklaidų dispersijos išskaidymas pabrėžia infliacijos, palūkanų normų ir kredito rinkų tarpusavio priklausomybę ir leidžia suprasti šių kintamųjų įtaką. Šiame tyrime pabrėžiama, kad labai svarbu aiškiai informuoti apie politiką ir taikyti koordinuotą strategiją, kurioje būtų panaudotos ir pinigų politikos, ir makro lygio rizikos ribojimo priemonės, kad būtų skatinamas ekonomikos stabilumas ir augimas.

A APPENDIX

A1 Variable source table

Variable	Source
GDP	European Central Bank
HICP	Federal Reserve Bank of St. Louis
Total/HH/Firm Credit	Bank of Lithuania
Macro-prudential policy variables	Bank of Lithuania
Avibor	Bank of Lithuania

Table 1
Variable source table