Dual-pillar policy frameworks and financial cycle fluctuation: Evidence from MS-VAR analysis

Yanhao Ma, Muhammad Ali Nasir, Ali Raza

Department of Economics, University of Leeds, United Kingdom

Abstract

This study employs a Markov Switching Vector Auto-regressive (MS-VAR) model to investigate the dynamic relationships between financial conditions and macroeconomic variables in four major economies including the US, UK, Eurozone, and China. The MS-VAR model is used to identify distinct regimes of financial expansion and contraction and to examine how these regimes influence the effectiveness of both monetary and macro-prudential policies. By identifying regime-specific financial expansions and contractions through a Financial Conditions Index (FCI), the research highlights the critical role of dual-pillar policy frameworks (monetary and macro-prudential policies) comprising monetary and macro-prudential measures. Key findings reveal that financial cycles demonstrate significant country-specific variations in duration and transition dynamics. During expansions, proactive macro-prudential policies effectively curb systemic risks, while contractions necessitate coordinated monetary easing and flexible macro-prudential adjustments to stabilize economies. Furthermore, the analysis emphasizes the differential effectiveness of these policies under varying financial cycle regimes, underscoring the need for adaptive, context-sensitive strategies tailored to distinct economic environments. These insights contribute to optimizing policy responses and enhancing economic resilience in the face of cyclical financial fluctuations.

Keywords: Dual Pillar Policy, Monetary Policy, Prudential Policy, Financial Condition Index, Financial Cycle, Markov Switching Vector Auto-regressive (MS-VAR)

1. Introduction

In both the natural and social sciences, the concept of cyclical reciprocation across diverse processes has consistently garnered significant interest within the scholarly community. The principle of economic cycle fluctuations represents a central area of inquiry within economic theory. The concept of the financial cycle gained prominence among scholars as they sought to understand the fluctuations in financial markets and their broader economic impacts. Researchers observed cyclical patterns in credit growth, asset prices, and leverage that were distinct from traditional business cycles. This idea finds resonance in Walter Bagehot's earlier work (cited in Bank of England, 2016), where he introduced the concept of central banks acting as the "lender of last resort" during financial crises. Bagehot argued that central banks should provide liquidity to solvent banks experiencing temporary difficulties, offering support at high interest rates and against good collateral. This approach would prevent systemic collapse while discouraging reckless behaviour by financial institutions. Building on Bagehot's ideas, Fisher (1933) introduced the "debt deflation" theory, asserting that excessive indebtedness reduces the velocity of money circulation and depresses price levels, potentially triggering economic recessions. Further expanding this framework, Minsky (1975) advanced the "financial instability hypothesis," which posits that periodic financial crises are a natural outcome of the intrinsic characteristics of financial intermediaries. In Manias, Panics, and Crashes: A History of Financial Crises, Charles Kindleberger articulates that financial crises typically follow a cyclical pattern characterized by initial euphoria, subsequent panic, and eventual crash. He contends that these cycles often begin with an over-expansion of credit and speculative investment, which leads to inflated asset prices (Kindleberger, 1978). This phase of exuberance eventually gives way to a reversal, triggered by events such as credit contractions or economic downturns, resulting in a swift transition from irrational optimism to widespread investor panic. Extending this line of inquiry, Bernanke et al. (1999) introduced the concept of the "financial accelerator." This theory suggests that endogenous dynamics within credit markets not only amplify but also propagate economic shocks across the macroeconomy. Their studies substantiate the assertion that the financial accelerator plays a significant role in influencing the dynamics of the business cycle. However, the onset of the 2008 crisis led an increasing number of scholars to recognize that the financial system not only has its own operating rules but also has a significant impact on the real economy. Drehmann et al(2012) analyses financial cycles after the outbreak of the crisis through turning points and frequency-based filters and gave similar conclusions that financial cycles are strongly linked to the financial crisis. Whereafter, Borio (2014) formally defines financial cycles as the amplification of economic fluctuations caused by the self-reinforcing interaction between attitudes towards risk and financial constraints.

The macro-prudential policy has been also increasingly studied after the crisis. It emerged from the realization that the traditional micro-prudential approach to financial regulation, which focuses on the soundness of individual financial institutions, was insufficient to ensure the stability of the financial system as a whole. The development of macro-prudential policy represents a significant evolution in financial regulation, aimed at addressing the systemic risks that may lead to financial crises and economic downturns (Borio,

2014; Galati and Moessner, 2013). Various tools have been identified and implemented as part of macro-prudential policy frameworks by policy markers in main economies. These include loan-to-value (LTV), debt-to-income (DTI) limits for borrowing, and measures to address systemic risks associated with specific sectors or financial activities (Akinci and Olmstead-Rumsey, 2018). Many related studies show that macro-prudential policy can enhance financial stability and demonstrate the effectiveness of macro-prudential policy. Rubio and Carrasco-Gallego (2012) employ a Dynamic Stochastic General Equilibrium (DSGE) model and find that introducing macro-prudential rules to limit credit can mitigate economic overheating issues. Rubio (2016) analyzes the ability of monetary and macro-prudential policies to stabilize the macro-economy and financial markets from both short-term and long-term perspectives. The results show that if the LTV macro-prudential policy tool is used, short-term financial stability improves significantly.

Despite the growing focus on macro-prudential policy, empirical research on the effectiveness of its interaction with other policy areas, such as monetary policy remains relatively underdeveloped. The limited exploration of this intersection leaves significant gaps in understanding how these policies can effectively complement each other, making it a critical and under-explored avenue for further academic inquiry and debate. Fahr and Fell (2017) contend that relying solely on monetary policy is insufficient for ensuring both price stability and financial robustness; they advocate for a more integrated framework that incorporates additional macro-prudential tools. Similarly, Hu et al. (2019) present evidence from Chinese economic data suggesting that a synergistic application of monetary and macro-prudential policies is far more effective than either approach in isolation. Dunstan (2014) echoes this sentiment, recommending the coordination of these policies to enhance their effectiveness. Expanding on this discussion, Claessens et al. (2010) emphasize the ability of macro-prudential tools, such as countercyclical capital buffers, to moderate the pro-cyclicality of financial systems and stabilize credit cycles. Galati and Moessner (2013) further explore these dynamics, noting that while aligned policies can mitigate systemic risks effectively, conflicting goals between monetary and macro-prudential frameworks can lead to suboptimal outcomes if not managed with care. Lim et al. (2011) provide a practical perspective by analyzing various macro-prudential instruments employed across 49 countries, underscoring the sector-specific efficacy of tools like loan-to-value ratios. Lastly, Jordà et al. (2013) utilize historical analysis to support the integration of macro-prudential measures with monetary policy, particularly as a preventative strategy against credit excess and asset price inflation.

This scholarly insight into the integration of macro-prudential measures with monetary policy underscores the complexities of effectively integrating macro-prudential and monetary policies. While the potential for enhanced stability through coordinated policy efforts is evident, the challenge of empirically grounding such integration across diverse national contexts remains an intractable issue for policymakers. Moreover, Gertler (2009) and Abbate et al. (2016) both argue that financial cycle fluctuation has a significant impact on macroeconomic operations. Dunstan(2014) has similar conclusions that under different stages of the economic and financial cycle, the interactions between the two policies are different.

The fluctuation can affect the effectiveness of combined policies. Therefore, the effectiveness of this dual-dimension policy control also varies across different stages of the financial cycle (expansion, contraction, recovery) and need to be further studied. There is no empirical evidence quantifying the effectiveness of the dual-pillar approach (combining macro-prudential and monetary policies) in different financial cycle stages. This study focuses on both theoretical models and sufficient real-world validation.

This article studies a dual-dimension policy, which means a macro-policy framework that combines monetary and macro-prudential policies and two key objectives: price stability and financial stability. It is designed to address both inflationary pressures and systemic risks in the financial system, recognizing that these factors are often interrelated and can have significant implications for the overall economy. Central banks implementing a dual-dimension policy use a combination of monetary policy tools and macro-prudential measures to achieve their goals. The dual-dimension policy acknowledges that the pursuit of price stability alone might not be sufficient to prevent financial crises or ensure the overall stability of the economy. Financial stability is crucial in preventing the buildup of systemic risks that could lead to a widespread breakdown of the financial system and have severe consequences for the real economy.

Nowadays, central banks need to strike a balance between price stability and financial stability, as actions taken to address one could have implications for the other. For example, lowering interest rates to stimulate economic growth and control inflation might also encourage excessive borrowing and asset price bubbles, which could undermine financial stability. As a result, central banks must carefully weigh the trade-offs and coordinate their monetary and macro-prudential policies to effectively manage both price and financial stability. Thus, it is crucial to examine the effectiveness of multiple countries' macroeconomic dual-dimension policies and to find a method to improve dual-dimension policy effectiveness.

This study makes the following assumptions:(1)The effectiveness of dual-dimension policy control varies across different stages of the financial cycle (expansion, contraction), so this study attempts to analyse the economic and financial data to prove this hypothesis and to find out some essential factors that affect the effectiveness of macro-policy. (2)The coordination between monetary policy and macro-prudential policy is essential for managing financial cycle fluctuations effectively. (3)The transmission mechanisms of dual-dimension policy control on the real economy and financial markets may vary across financial cycle stages. This study tends to further discover what makes the effectiveness of dual-pillar policies different in different states of the financial cycle, so the transmission through economic and financial factors may affect the result of macro-policy control. (4) The effectiveness of the dual-pillar policy may vary across the four selected regions—China, the United States, the United Kingdom, and the Eurozone—due to differences in financial cycles. These variations are expected to arise from the distinct financial structures, macroeconomic environments, and regulatory frameworks of each region, which may influence how the dual-pillar policy operates at different stages of the financial cycle. Consequently, the policy's impact may exhibit significant regional disparities depending on the specific financial

conditions present in each area.

Despite the growing body of literature on financial cycles, macro-prudential policies, and monetary policy interactions, there remains a significant gap in the academic study of the effectiveness of monetary and macro-prudential policies under the influence of financial cycle fluctuations. While existing research has explored each policy individually, empirical investigations that examine their combined effectiveness during different stages of the financial cycle are limited. Current studies have primarily focused on the short-term impacts of monetary policies or the isolated effects of macro-prudential tools, but they have largely neglected how the dual-pillar approach (combining both monetary and macro-prudential policies) performs across varying financial conditions, such as expansion and recession phases.

This research aims to fill this gap by employing an MS-VAR model to analyze the dynamic interactions between these two policies during different financial cycles, focusing on key economies such as the US, UK, Eurozone, and China. By doing so, it provides a comprehensive empirical foundation for understanding the effectiveness of dual-pillar policies in managing financial fluctuations and promoting economic stability, thus contributing valuable insights to a relatively unexplored yet crucial aspect of modern macroeconomic policy. This study also makes a significant contribution by utilizing the Cumulative Impulse Response Function (CIRF) method to construct the Financial Condition Index (FCI). Additionally, it contributes to the literature by calculating China’s shadow rate and incorporating shadow rates from four major economies—China, the UK, the US, and the Eurozone—into the MS-VAR model. The study compares the results derived from inter-bank rate analysis with those using shadow rates, providing an in-depth analysis of the differences and exploring the advantages and disadvantages of using shadow rates in monetary policy transmission analysis.

The remainder of this paper is structured as follows: Section 2 provides a comprehensive review of the relevant literature, outlining the theoretical frameworks and empirical findings that underpin this study. Section 3 details the research methodology for constructing FCI and MS-VAR models, including data sources and analytical techniques. Section 4 presents the empirical results, highlighting the key findings and their implications. Finally, Section 5 concludes the paper by summarizing the main findings and suggesting avenues for future research.

2. Literature review

2.1 Financial cycle theory

The concept of the financial cycle has evolved, with its roots in earlier economic theories and observations about the behaviour of financial markets, asset prices, and credit. Unlike the business cycle, which has been studied extensively since the 19th century, the financial cycle concept began to gain prominence more recently, especially following the global financial

crisis of 2007-2008. In the 20th century, Economists like Irving Fisher and later Hyman Minsky hinted at phenomena similar to the financial cycle through their work on debt deflation and financial instability hypothesis, respectively. These theories emphasized the role of credit and debt cycles in economic fluctuations.

Fisher's (1933) "debt deflation" theory suggested that excessive debt could lead to businesses selling assets, which in turn would result in a decrease in the velocity of money circulation and price levels. Subsequently, the decline in corporate net assets and profits would force companies to reduce production, trade, and employment, leading to further economic recession. In this process, excessive debt and falling asset prices are both causes and effects of the recession. Bernanke (1999) finds that the “financial accelerator”, a mechanism where credit market frictions amplify and propagate economic shocks, significantly affects business cycle dynamics. By incorporating key features such as price adjustments, investment processes, and firm diversity, the model quantitatively demonstrates how variations in the external finance premium influence investment and production. Through simulations, it highlights the substantial role of the financial accelerator in magnifying responses to monetary policy and economic shocks, thereby affecting asset prices, investment decisions, and overall economic activity. The financial accelerator explains how financial factors influence economic cycle fluctuations. This theory of the financial-economic cycle primarily addresses how financial liberalization enhances the impact of the financial sector on the real economy, surpassing traditional technological shocks and leading to frequent short-term economic fluctuations.

Following the outbreak of the global financial crisis in 2008, the role of financial cycle fluctuations in macroeconomic operations has garnered increasing attention. Prior to the crisis, although it was recognized that financial development was a double-edged sword for economic prosperity, it was deemed necessary to develop financial services for the real economy while preventing potential financial risks. The global financial crisis in 2008 demonstrated that the financial system not only has its own operational rules but also has a significant impact on the real economy.

Different from Bernanke, Borio (2014) proposed the concept of the financial cycle. His definition places greater emphasis on observing the patterns of changes in financial variables themselves, highlighting the intrinsic dynamics of financial factors, particularly the interactions between credit and asset prices, which result in either an upward or downward spiral of financial variables. His theory focused on the changing patterns of financial variables and the self-development of the financial cycle, primarily investigating the internal evolution mechanism of the financial cycle and its impact on the macro-economy. He identified five typical characteristics of the financial cycle for future studies on it. Firstly, credit and asset prices are the financial variables that best represent changes in the financial cycle. Secondly, the frequency of the financial cycle is lower than that of the economic cycle. Thirdly, the peak of a financial cycle is closely associated with a financial crisis. Furthermore, the characteristics of the financial cycle can accurately forecast financial crises. Lastly, the amplitude and wavelength of the financial cycle are related to the economic system and other institutional factors.

Drehmann et al.(2012) also put forward similar argument that financial cycles exceed the duration of traditional business cycles, with recessions deeper during financial cycle

contractions. By analyzing financial cycles through turning points and frequency-based filters and identifying them primarily through medium-term fluctuations in credit and property prices. He shows that financial cycles, distinct from equity price movements, are strongly linked to financial crises and have grown longer and more pronounced since the mid-1980s, attributed to financial liberalization and changes in monetary policy. He warns of "unfinished recessions," where short-term policy responses may defer, but ultimately worsen, future downturns. Similarly, an empirical study from Hiebert(2018) also finds that financial cycles have greater amplitude, longer duration, and more symmetry compared to business cycles. His article examines the differences between financial and business cycles in 13 European Union countries and finds financial cycles align with business cycles about two-thirds of the time, showing weaker synchronicity in countries with persistent financial downturns. Various economic mechanisms, such as debt overhang and financial shocks, are explored to explain these differences. His study also emphasizes the potential conflict between macroeconomic stabilization and financial stability objectives, suggesting a need for differentiated policy approaches. Another empirical study from Ma(2016) suggests that financial cycles significantly influence business cycles and that financial shocks are a major driver of macroeconomic fluctuations, particularly during financial instability periods. The study investigates the interactions between financial cycles, business cycles, and monetary policy across four major economies (USA UK Japan China) using a four-equation model and suggests that incorporating a financial stability objective into the Taylor rule—a principle guiding monetary policy adjustments—enhances economic and financial system stability compared to a conventional Taylor rule. This supports the argument for including financial stability as a monetary policy target. However, Adarov's(2022) study has different results. His article yields financial cycles that have a frequency of around 12 years, on average, for smoothed cycles (mostly falling into the range of 9–15 years), as opposed to 16 years, as suggested in Borio (2014) and Drehmann et al. (2012). By exploring the dynamics of financial cycles across 34 advanced and developing countries from 1960 to 2015 he employs dynamic factor models and state-space techniques to extract financial cycles in credit, housing, bond, and equity markets as common factors. The study reveals that financial cycles are highly persistent, tend to last longer than business cycles which is consistent with previous studies' findings, and are closely associated with episodes of financial distress. It also notes significant intra-regional synchronization of financial cycles and confirms the existence of a global financial cycle linked to US T-Bill rates and the VIX index.

In summary, although the duration of financial cycles cannot be precisely determined, studies in this area generally agree that financial cycles span longer than economic cycles and exert significant influence on them.

2.2 Measurement of financial cycles

To examine the effectiveness of macroeconomic policies under different stages of financial cycles, it is necessary to have a method for measuring financial cycles. Most studies choose to construct a Financial Conditional Index to measure financial cycle fluctuations, which can more comprehensively reflect the information pertaining to these fluctuations.

About how to construct a FC Index, previous researches adopt the approach of using

either two or three indicators to construct composite indices to characterize financial cycles. The two-indicator method primarily focuses on credit indicators and real estate price indicators (Drehmann et al., 2012; Ardila and Sornette, 2016), while the three-indicator method adds an indicator reflecting stock price volatility to these two (Claessens et al., 2012).

Some scholars use multiple variables to establish the FC Index. For example, Plašil et al. (2016) utilized data on credit, asset prices, debt sustainability, borrowing conditions, stock price index, and the proportion of adjusted current account deficit in GDP to construct a comprehensive FC Index that captures financial cycle fluctuations. Furthermore, the calculation of FCI incorporates the correlation coefficient between variables, making the change in FCI more significant when multiple variables shift simultaneously compared to when a single variable changes significantly. This reflects the characteristic of multiple variables fluctuating simultaneously within the financial cycle and emphasizes the interactive nature of variables within the cycle.

Other scholars use the time series model to measure financial cycles. For instance, Galati et al. (2016) employed a time series model with FC Index as a variable to extract the financial cycles of the United States, Germany, France, Italy, Spain, and the Netherlands. Their empirical results showed that: (1)credit and real estate prices effectively captured financial cycle fluctuations.(2)the persistence, length and amplitude of the extracted cycles vary over time and vary across countries. Relying on quarterly data of financial variables such as bond and stock prices, Schuler et al. (2015) adopted a time-varying multivariate time series model with FCI to measure the financial cycle of EU countries. They found that the cyclical fluctuation patterns of credit and asset prices were highly similar, and the financial cycle—particularly the upward phase—tended to last longer, with an average length of 7.2 years. Financial cycles between countries were more synchronized than financial and economic cycles within a country.

Current studies have developed country-specific FCIs using multiple indicators for major economies such as the United Kingdom, the United States, the Eurozone, and China, each reflecting the unique financial structures and policy environments in these regions. The following section provides an overview of the existing research on the use of FCI in these key economies, highlighting the methodological approaches and key findings that inform the current understanding of financial cycle analysis.

As for the UK, the bank of England has an index using a variety of indicators to reflect the overall financial conditions in the UK. These indicators include short-term interest rates (the 3-year instantaneous forward overnight index swap rate), exchange rates (specifically the Sterling Exchange Rate Index, £ERI), stock market indices such as the FTSE 100, credit conditions including credit growth rates and household credit conditions, and credit spreads between corporate bonds and government bonds. Each of these indicators is weighted based on its estimated marginal impact on UK GDP to create a comprehensive measure of financial conditions (Bank of England, 2019a; Bank of England, 2021).

As for the US, Hatzius and colleagues (2010) developed a financial conditions index that includes indicators such as interest rates, credit spreads, equity prices, and other financial

variables to assess the overall financial environment. The index combines information from various sources to provide a comprehensive measure of financial conditions, particularly focusing on how these conditions impact economic activity and predict potential stress. Brave and Butters (2011) from the Federal Reserve Bank of Chicago constructed their financial conditions index using a range of financial market variables. These include short-term and long-term interest rates, yield spreads, stock market indices, and measures of market volatility. Their approach focuses on summarizing these indicators to monitor financial stability and provide insights into the health of the financial system.

As for the Euro area, Key indicators include short-term interest rates (3-month EURIBOR and Overnight Indexed Swap (OIS) rates) and long-term interest rates (10-year government bond yields), which capture the cost of borrowing and market expectations of future economic activity (Darracq Pariès, Maurin, & Moccero, 2014). Credit spreads, such as corporate bond spreads over government bonds and sovereign bond spreads between periphery and core Eurozone countries, are crucial for assessing the risk premiums required by investors (Kremer, Lo Duca, & Holló, 2012). Equity market indicators, including major stock indices like the Euro STOXX 50 and market volatility measures such as the VSTOXX, provide insights into investor sentiment and market stability. Bank lending conditions, as reflected in the ECB's Bank Lending Survey and bank credit growth rates, indicate the ease with which businesses and households can access financing. Additionally, residential property price indices are used to monitor trends in the housing market, which can significantly impact financial stability.

Several studies have constructed Financial Conditions Indices (FCI) for China by incorporating a range of key financial and economic indicators. Chen et al. (2011) utilized indicators such as the one-year loan interest rate, the seven-day interbank pledged repo rate, M2 money supply growth, total social financing growth, the Shanghai Composite Index, the RMB/USD exchange rate, and real estate price indices. Zhang (2013) included the one-year deposit interest rate, the ten-year government bond yield, bank loan growth, the Shanghai Composite Index, the real effective exchange rate, and the consumer price index (CPI) growth rate. Wu et al. (2015) employed the Shanghai Interbank Offered Rate (SHIBOR), total social financing stock growth, the CSI 300 Index, the RMB/USD nominal exchange rate, national residential sales price indices, and M2 growth.

Despite the variations in FCI constructions across different countries, researches tend to select variables that exhibit a certain degree of commonality. In constructing this FCI, credit indicators and real estate price indicators were chosen as the foundational factors. These two variables were selected because they provide a robust and stable basis for capturing financial conditions across different countries. The decision to exclude stock price indices was made due to their excessive volatility, which can introduce noise and obscure the underlying financial trends the FCI aims to capture. Furthermore, exchange rates were not included as a variable, as the primary focus of this study is on domestic financial conditions, where exchange rates might not directly reflect the internal financial environment.

Through these studies, it can be found that FCI is a commonly used index in academia to measure financial conditions. However, there is no consensus among scholars on how to construct a suitable FCI index, and they usually incorporate various variables into the index based on their understanding. This study constructs a new Financial Conditions Index (FCI) by applying the advanced Cumulative Impulse Response Function (CIRF) method to obtain a more accurate measure of the financial conditions in the selected regions, aligning it more closely with historical financial fluctuations.

2.3 Macro-prudential policy

The global financial crisis of 2008 sparked extensive discussions among policymakers and researchers regarding the necessity of macro-prudential policies. This led to a surge of interest in macro-prudential studies in academia. Many countries began to deeply reflect on their existing regulatory frameworks, highlighting the urgent need for new policy tools or regulatory approaches. Subsequently, scholars provided numerous exploratory directions from a macro-prudential perspective for reference.

Credit (growth rate) and real estate prices are important variables for observing the financial cycles. Many scholars approach the study of macro-prudential policies' role in financial stability from this perspective. Some scholars have employed numerical simulation methods. For example, Rubio and Carrasco-Gallego (2012) employed a Dynamic Stochastic General Equilibrium (DSGE) model, using the real estate market as a representative, to assess the interaction between Loan-to-Value (LTV) rules and traditional monetary policy implemented by central banks. The results demonstrate that introducing macro-prudential rules to limit credit can mitigate economic overheating issues. Furthermore, when both policies are actively implemented, the impact of interest rate shocks on the economy is weakened. The combination of monetary policy and macro-prudential rules undoubtedly improves welfare, especially in cases where monetary policy focuses solely on inflation without responding to output and house prices. Rubio (2016) analyzes the ability of monetary and macro-prudential policies to stabilize the macro-economy and financial markets from both short-term and long-term perspectives under two different scenarios. In the constructed DSGE model, with features mainly focused on the real estate market, borrowers, and depositors, borrowers could access credit markets through their housing collateral. The author studies two ways to enhance financial stability: one being monetary policy reacting to credit growth using interest rates as a tool, and the other being macro-prudential Loan-to-Value (LTV) tools. The results indicate that the long-term effectiveness of both monetary and macro-prudential policies is poor. However, in the short term, monetary policy can only achieve financial stability objectives at the expense of increased macroeconomic volatility. If the LTV macro-prudential policy tool is used, short-term financial stability improves significantly, but long-term improvement is only marginal.

Some scholars have studied the effectiveness of macro-prudential policies through empirical analysis and argue that such policies are effective. Zhang and Zoli (2016), based on macro-prudential tools and capital flow data from 13 Asian economies and 33 other economies, examine the effectiveness of various policy instruments. Asian economies utilize macro-prudential tools more extensively, particularly measures related to real estate. The

analysis indicates that macro-prudential tools associated with housing, especially loan-to-value ratio and housing tax measures, effectively curb the rise in housing prices, credit growth, and bank leverage in Asia. Oriol et al. (2016), based on panel data from OECD countries, similarly conclude that macro-prudential policies could effectively restrain housing prices and credit growth. However, they find variations in the effectiveness of different policy instruments. Mirna (2018) and Mirzaei et al. (2021) support the conclusion that macro-prudential policies effectively restrain credit growth. Mirna categorizes credit demand into household and non-financial corporate sectors and finds that macro-prudential policies were relatively more effective in curbing credit growth in the household sector. Akinci and Olmstead-Rumsey (2017) identified several key characteristics of macro-prudential policies in major economies. Firstly, countries have increased the implementation of macro-prudential policies post-crisis. Secondly, these policies predominantly target the housing sector, particularly in advanced markets. Thirdly, macro-prudential policies often coincide with adjustments in bank reserve requirements, capital flow restrictions, and monetary policy.

In addition to studies related to credit, real estate prices, and leverage ratios, some scholars approach the issue from the perspective of systemic financial risk. They agree that macro-prudential policy could enhance financial stability. Fouejieu et al. (2019) discuss issues related to financial risk mitigation. In their constructed economic model, the authors examine how central banks, with a focus on financial stability, balance between macroeconomic and financial stability objectives. Through simulations of a New Keynesian model incorporating endogenous financial bubbles, the results indicate that central banks acting contracyclically might face trade-offs between inflation, output stabilization, and financial stability. Therefore, the authors suggest that interest rate tools should be used to achieve traditional macroeconomic objectives, while macro-prudential tools should complement policy rates to address the accumulation of financial risks. Stanga et al. (2020) find that tightening macro-prudential policies, particularly lower loan-to-value ratios, could significantly reduce the proportion of residential mortgage defaults. They use data from 26 countries or regions between 2000 and 2014 to analyze international differences in mortgage defaults.

To illustrate, scholars explore various aspects of macro-prudential policies, finding them effective in curbing financial instability. Studies show that measures such as credit growth restrictions and changes in loan-to-value ratios help reduce the likelihood of bank crises and mortgage defaults. While the effectiveness may vary across countries and policy instruments, overall, macro-prudential policies are seen as beneficial for enhancing financial stability.

2.4 Macro-prudential policy coordinating with Monetary policies

Following the introduction of macro-prudential policy, extensive research has been conducted to explore both its fundamental characteristics and its effectiveness when combined with other policy measures. This body of work examines the independent functioning of macro-prudential policies as well as their potential synergies when integrated with broader regulatory frameworks.

In particular, a growing number of studies have focused on the coordination between macro-prudential and monetary policies. However, the findings are not always consistent. Some researchers argue that the coordination of these two types of policies can enhance social welfare by leveraging their combined effects, thereby advocating for policy cooperation (Kannan et al., 2012; Suh, 2012; Angelini et al., 2012; Bailliu et al., 2012; Unsal, 2013; Bruno et al., 2017). Specifically, Kannan et al. (2012) highlight that countercyclical macro-prudential policies have a stabilizing influence on credit market cycles. When monetary policy simultaneously responds to credit expansion and asset price inflation, the joint implementation of both policies can further contribute to macroeconomic stability. Suh (2012) argues that monetary policy aimed at inflation stabilization and macro-prudential policy focused on credit control are both optimal, with simultaneous use in response to financial shocks significantly improving social welfare.

Angelini et al. (2012) demonstrate that monetary and macro-prudential policies can jointly stabilize financial and real estate markets when faced with negative external shocks. In such cases, the stabilizing impact of macro-prudential policy becomes more pronounced in the presence of monetary policy. Similarly, Bailliu et al. (2012) suggest that both policies can address financial imbalances, with the introduction of macro-prudential tools enhancing the effectiveness of monetary policy and improving overall societal welfare. Some scholars also point out that monetary policy and macro-prudential policy may potentially weaken their respective economic stabilization effects due to conflicts in objectives and tools. It is found that there is channel overlap and policy conflicts between the two policies in regulating bank credit and asset prices, which may weaken their policy effects to some extent (Unsal, 2013). Therefore, separate objective functions need to be set for the two policy departments (Beau et al., 2012). Sometimes, the relationship between the two policies depends on both the type of exogenous shocks and the influence of model parameters. This results in a mutual weakening trend in the policy effects between macro-prudential policy and monetary policy under the influence of conventional shock effects and parameter settings (Aikman et al., 2018)

Other studies of the interaction between macro-prudential policy and monetary policy from financial stability perspective reveal the significance of their combined effects. Fahr and Fell (2017) emphasize the need for new tools in the macro-prudential policy toolkit post-global financial crisis, suggesting that macro-prudential policies are more effective than monetary policies in ensuring financial stability. Hu et al. (2019) find that integrating macro-prudential rules with monetary policy can stabilize the economy more effectively than monetary policy alone, highlighting the importance of coordinated policy approaches. Additionally, Biljanovska et al. (2023) stress the effectiveness of macro-prudential policies in extreme events and their ability to reduce systemic risk when implemented alongside other policies. Despite short-term negative effects on economic growth, the long-term benefits of macro-prudential measures in terms of stability are substantial, underscoring the significance of timing and targeting in their application.

2.5 The influence of financial cycle fluctuation on macroeconomic policy effectiveness

The existing literature demonstrates the impact of financial fluctuations on the economy and the efficacy of economic policies. Interactions between the financial system and the real economy became deeper, particularly evidenced by the global economic recession following the financial crisis. Some articles start from the perspective of the impact of financial variables to explore the affect of fluctuations in the financial cycle on the operation of the macro-economy (Claessens et al., 2012; Gertler, 2009; Abbate et al., 2016). These studies prove that economic growth accelerates during financial booms, while it slows down during financial downturns and positive financial shocks bolstered economic growth while negative shocks had adverse effects.

Researchers also find that the financial cycle has predictive power for fluctuations in output and other macroeconomic variables (Schularic and Taylor, 2012; Gauthier et al., 2004). An empirical analysis from Tian and Lu (2019) indicates that financial cycle fluctuations serve as indicators of macroeconomic performance, with time-varying effects on macroeconomic cycles and prices. They employ a dynamic factor model to construct a financial cycle composite index (FCI) based on indicators such as asset prices, credit scale, and bank spreads. Utilizing the FCI alongside macroeconomic prosperity and consumer price indices, they then employ a TVP-VAR model to analyze the time-varying impact of financial cycle changes on China's macroeconomic cycle and inflation.

Studies on macroeconomic control during financial cycle fluctuations gained traction in the aftermath of the 2008 global financial crisis. This led to debates regarding the role of monetary policy in prioritizing financial stability and integrating financial variables into its framework. Woodford (2012) argues that monetary policy should adapt to incorporate financial stability concerns alongside inflation targeting objectives, proposing a flexible approach that aims to maintain stable inflation expectations while mitigating risks to financial stability. In a similar vein, Collard et al. (2017) suggest that the monetary authority should focus on achieving price stability, while the macro-prudential authority should prioritize financial stability. Their New Keynesian model explores optimal monetary and prudential policies, identifying conditions under which each policy effectively addresses financial fragility and macroeconomic stability.

In the context of studying the effectiveness of dual-dimension policies, scholars have studied the impact of them on the control of macroeconomic variables such as output and inflation under financial cycle fluctuations. Though researching from different aspects, they agree that the fluctuation of financial cycles truly has an impact on macroeconomic variables. Laeven (2011) argues that the implementation of macro-prudential policies and the restriction of explicit or implicit government guarantees for bank debts can enhance the stability of the financial system. Zdzienicka et al. (2015) analyze the impact of policy shocks on financial variables and find that monetary policy had a significant and sustained impact on the financial situation, while the impact of macro-prudential policy measures is usually more direct but lasts for a relatively short time. Angelini et al. (2011) established a DSGE model to study the relationship between monetary policy and macro-prudential policy and found that the introduction of macro-prudential policy had a significant effect on maintaining

macroeconomic stability during the economic crisis. Matheron and Antipa (2014) examine the effects of monetary policy and macro-prudential policy based on the DSGE framework and Eurozone data, and find that macro-prudential policy effectively played a complementary role to monetary policy during the crisis by alleviating the decline in investment and even output.

Overall, existing study mainly focuses on the effects of monetary policy itself or macro-prudential policy itself under financial cycle fluctuations, with fewer studies on how to coordinate the implementation of the two policies, and empirical studies on the coordination effects of the two policies under financial cycle fluctuation is also limited. This study contributes by shifting the focus from examining monetary policy or macro-prudential policy in isolation to investigating the effectiveness of their coordinated interaction. This approach not only fills a gap in the existing literature but also offers valuable insights for policymakers aiming to optimize the use of both policies in managing financial cycles and mitigating systemic risks.

Table 1: summary of the literature

Author(s) and Year	Key Findings
Duration and Characteristics of Financial Cycles	
Borio (2014)	Financial cycles have a longer duration compared to business cycles, often linked to financial crises, and influenced by credit and asset prices.
Drehmann et al. (2012)	Financial cycles last longer than traditional business cycles and are linked to periods of financial distress.
Adarov (2022)	Financial cycles are highly persistent, lasting around 12 years on average, which is slightly shorter than previous estimates of 16 years.
Financial Amplification Mechanisms	
Bernanke (1999)	Introduces the financial accelerator, highlighting how credit market frictions amplify economic shocks, affecting investment and economic activity.
Ma (2016)	Financial shocks significantly influence business cycles in major economies, suggesting that incorporating financial stability into policy enhances macroeconomic stability.
Financial Cycle and Crisis Prediction	
Hiebert (2018)	Financial cycles have greater amplitude, longer duration, and are more synchronized with business cycles in 13 European countries. Financial cycles align with business cycles about two-thirds of the time.
Composite Index Construction	
Drehmann et al. (2012)	Use two indicators (credit and real estate prices) to construct an FCI to characterize financial cycles.
Claessens et al. (2012)	Add stock price indicators to create a more comprehensive FCI.
Plašil et al. (2016)	Use multiple variables, including credit, asset prices, and others, to construct an FCI that captures the interactive nature of

	financial variables.
Country-Specific FCIs	
Bank of England (2019, 2021)	Construct an FCI for the UK using multiple indicators like interest rates, exchange rates, stock market indices, and credit conditions.
Hatzius et al. (2010)	Develop a financial conditions index for the US including interest rates, credit spreads, equity prices, and other financial variables.
Chen et al. (2011)	Construct an FCI for China using indicators like loan interest rates, M2 money supply growth, and the Shanghai Composite Index.
Time Series Approaches to Measurement	
Galati et al. (2016)	Use a time series model to extract financial cycles in several countries, finding that credit and real estate prices effectively captured financial cycle fluctuations.
Schuler et al. (2015)	Use a time-varying multivariate model to measure financial cycles in EU countries, finding high synchronization across countries.
Effectiveness of Macro-prudential Policy Tools	
Zhang & Zoli (2016)	Macro-prudential tools like LTV ratios are effective in curbing housing prices, credit growth, and leverage.
Akinci & Olmstead-Rumsey (2017)	Macro-prudential policies are increasingly used post-crisis, particularly targeting the housing sector.
Fouejieu et al. (2019)	Macro-prudential tools should complement traditional monetary policies to mitigate financial risks
Empirical Limitations of Macro-prudential Policies	
Rubio & Carrasco-Gallego (2012)	LTV limits mitigate overheating in the short-term but have limited long-term economic stability impact.
Rubio (2016)	Macro-prudential tools are mainly effective in the short-term but insufficient for achieving lasting stability.
Impact on Financial Stability	
Stanga et al. (2020)	Tightening macro-prudential policies, such as lower LTV ratios, significantly reduces residential mortgage defaults.
Synergy Between Macro-prudential and Monetary Policies	
Kannan et al. (2012)	Countercyclical macro-prudential policies have a stabilizing influence when used alongside monetary policy.
Angelini et al. (2012)	Macro-prudential and monetary policies jointly stabilize financial and real estate markets under negative shocks.
Bailliu et al. (2012)	Macro-prudential tools enhance the effectiveness of monetary policy, especially during external shocks.
Potential Conflicts Between Policies	

Unsal (2013)	Overlap between macro-prudential and monetary policy channels can lead to conflicts, weakening their stabilization effects.
Aikman et al. (2018)	The relationship between macro-prudential and monetary policies may depend on external shocks, sometimes leading to mutual weakening.
Impact of Financial Cycle on Economic Growth	
Claessens et al. (2012), Gertler (2009), Abbate et al. (2016)	Fluctuations in the financial cycle significantly impact macroeconomic variables. Economic growth accelerates during financial booms and slows down during downturns. Positive financial shocks bolster economic growth, while negative shocks have adverse effects.
Schularic & Taylor (2012), Gauthier et al. (2004)	The financial cycle has predictive power for fluctuations in output and other macroeconomic variables.
Effectiveness of Policy Responses	
Laeven (2011)	The implementation of macro-prudential policies and the restriction of government guarantees for bank debts can enhance financial stability.
Zdzienicka et al. (2015)	Monetary policy has a significant and sustained impact on financial conditions, while macro-prudential policy measures are usually more direct but have short-term effects.
Angelini et al. (2011)	Using a DSGE model, the study finds that macro-prudential policies significantly contributed to macroeconomic stability during the crisis.
Matheron & Antipa (2014)	Analyzes the effects of monetary and macro-prudential policy using Eurozone data, finding that macro-prudential policy complements monetary policy during crises, alleviating declines in investment and output.
Coordination of Macro-prudential and Monetary Policies	
Woodford (2012)	Advocates that monetary policy should incorporate financial stability concerns alongside inflation targeting to maintain stable inflation expectations while mitigating financial risks.
Collard et al. (2017)	Suggests that monetary policy should focus on price stability, while macro-prudential policy should prioritize financial stability, employing a New Keynesian model to explore optimal strategies.

3. Methodology

3.1 Data selection

This study will select the financial and economic data of the US, China, the UK and the

Eurozone n from 2006 to 2023 because this period includes at least two relatively big financial crises (the Global Financial Crisis, the Eurozone Crisis and Covid-19). This makes it advantageous to analyze the effects of economic policies. However, due to some countries implementing some macro-prudential policies just recently, the start date would change in some countries' ms-var model.

(3.2) Countries selection

This paper chooses four countries China, the US, the UK, and the EU for the following reasons.

Representation and Diversity: China, the US, the UK, and the EU represent different economic systems and stages of development. The US and the EU are developed economies offering insights from mature markets; China provides a perspective from a rapidly developing emerging market; the UK offers a unique case, especially post-Brexit, highlighting changes in economic policies.

Economic Scale and Global Impact: These economies have significant global influence and substantial economic sizes, making them major players in the global economy. The US and the EU (particularly Germany and France) are often seen as benchmarks for Western economic policies, while China's rise impacts the global economic landscape profoundly.

Policy Tools and Experiments: These regions are characterized by distinct macroeconomic policy implementations. For instance, China has a high degree of government control over economic policies, whereas the US and the EU tend to favour market-oriented approaches.

(3.3) Identify financial cycle conditions

Financial Conditions Index (FCI) can serve as a comprehensive indicator, effectively reflecting the interaction between financial markets and the macroeconomy(Bank of England, 2021; Kapetanio and Price, 2017). They not only aid in forecasting economic activity but also provide significant reference points for policy formulation.

FC Index is usually used to measure financial cycle fluctuations by integrating multiple indicator information. Some studies select multiple indicators to construct the Financial Conditions Index (FCI) in order to comprehensively reflect the financial situation. For example, English et al. (2005) selected dozens of indicators in their paper, including interest rates, exchange rates, risk spreads, asset prices, and credit to depict the financial conditions in Germany, the United States, and the United Kingdom. On the other hand, some literature only selected asset prices and credit volume as indicators to construct the FCI. For instance, Galati et al. (2016) chose real estate and credit indicators to measure the financial cycles in the Eurozone and the United States from 1970 to 2014. Therefore, there is no consensus in the academic community regarding the selection of indicators. The FCI construction process not

only involves the selection of indicators but also the determination of weights. Similar to the selection of indicators, there are also various methods for determining weights. The two main methods are determining weights based on the cumulative impulse response values of the VAR model and based on the contribution rates of the principal components obtained through principal component analysis.

This research also considers to use of FCI to describe financial fluctuation. This paper aims to construct a Financial Conditions Index (FCI) that accurately reflects the real financial conditions of the target country. Consequently, the included indicators vary across different countries. First, convert each indicator to a standardized score, often using the z-score method. The z-score for any indicator is calculated as:

$$Z = \frac{(x - \mu)}{\sigma} \quad (1)$$

Here, μ means mean value and σ means standard error. Second, based on a common FCI equation：

$$FCI = w_1.z_1 + w_2.z_2 + ... + w_n.z_n \quad (2)$$

The advantages of using credit indicators and real estate prices in constructing the FCI are also significant. Credit indicators offer a direct measure of financial market conditions, reflecting the availability and cost of borrowing, which are crucial to understanding broader economic activity and financial stability. Real estate prices, on the other hand, provide insights into asset valuations and household wealth, which are closely linked to consumer confidence and spending. Together, these two factors capture key aspects of the financial system that are both sensitive to changes in economic policy and reflective of the overall financial health of the economy. By focusing on these stable and relevant indicators, this FCI is able to provide a more consistent and accurate assessment of financial conditions over time, avoiding the potential distortions caused by more volatile or externally influenced variables.

This study employs the Cumulative Impulse Response Function (CIRF) to determine the weights for the FCI. Drawing on relevant literature, CIRF exhibits significant advantages in capturing the dynamic relationships and causal effects between economic variables, rendering it a more scientific and precise method for constructing composite indices compared to other approaches. Firstly, CIRF effectively captures the dynamic impacts and time-lagged effects between variables. Stock and Watson (2001), as well as Christiano et al. (1999), highlight that the Impulse Response Function (IRF) and its cumulative form (CIRF) can quantify the causal relationships and transmission mechanisms among various economic variables. Furthermore, CIRF comprehensively considers the interactions among multiple variables. Lutkepohl (2005) emphasizes the superiority of the VAR model and its derivative CIRF method in multivariate time series analysis, allowing for a simultaneous examination of the interrelationships within a system and offering a holistic view of dynamic influences. CIRF provides a concrete, quantifiable metric, making the relationships between variables more intuitive and

interpretable (Brave & Butters, 2011). By quantifying the cumulative effects of economic variables, the CIRF method reduces subjective judgment and enhances the scientific rigour and reliability of weight allocation.

Therefore, this paper chooses to use CIRF to determine the weights of the FCI. Since the data is obtained on a monthly basis, the X12 seasonal adjustment method is first applied to the data to obtain long-term trends. Then, logarithmic differencing is used to obtain growth rates, and the HP filter method is applied to obtain the gap values of the data. HP filter method can effectively separate the long-term trend from short-term fluctuations in a time series, making it easier to analyze the underlying trend. Given the close relationship between the financial cycle and monetary factors, the data includes certain price elements. The data sources are the central bank websites of the selected countries. To differentiate from existing FCI models in the literature, this paper will establish a lag 2 VAR model of each variable and GDP growth rate. Subsequently, the cumulative impulse response values of economic growth to shocks in the gap values of other variables will be used as the indicator weights. Finally, the FCI will be constructed according to the following equation:

$$FCI = w_1.z_1 + w_2.z_2 + ... + w_n.z_n \quad (3)$$

After building FC Index, this paper test it through whether it reflects the true financial conditions. .

Next, this paper will transfer FCI to a regime transition variable. Assume that the variable FCI is affected by the unobservable state variable st and is in two states. When st=1, it is in a state of financial prosperity, and when st=2, it is in a state of financial contraction. The conditional mean values of the FCI in different regimes are μ1 and μ2, respectively, and the regression errors follow a normal distribution with variances related to the regimes. The equation is

$$FCI_t = \mu_{st} + \sigma(s_t)\varepsilon_t \quad (4)$$

Thus, this study could get the regime transition probability of FCI and use it as the transition variable.

3.4 MS-VAR model

The Markov regime-switching vector auto-regression (MS-VAR) model can analyze nonlinear economic phenomena with parameters that change across regimes. It is a non-linear time series model that captures structural breaks and regime shifts in the relationships among variables. It is particularly useful in analyzing how economic relationships might change over time due to different regimes, such as periods of high and low uncertainty. Moreover, the division of regimes is based on the data itself, which avoids subjectivity in the settings.

Hamilton (1989) first introduces the Markov-switching model to analyze economic cycles. Although the article mainly focuses on single-variable models, it laid the foundation for the subsequent development of the MS-VAR model. Krolzig(1997) provides a detailed

introduction to the MS-VAR model, including model construction, statistical inference, and applications. Other studies also use the MS-VAR model to analyse regime switches in monetary policy(Sims and Zha, 2006; Goodhart and Hofmann, 2000; Cogley and Sargent, 2005)

Each regime is associated with a different set of parameters. The regime at time t is denoted by S_t, which follows a Markov chain with transition probabilities:

$$P_{ij} = \Pr(s_{t+1} = j \mid s_t = i), \sum_{j=1}^{M} P_{ij} = 1 \forall i, j \in \{1,..., M\} \quad (5)$$

where p_{ij} is the probability of moving from regime i to regime j.

The common equation is

$$y_t - \mu(s_t) = A_1(s_t)(y_{t-1} - \mu(s_{t-1})) + ... + A_p(s_t)(y_{t-p} - \mu(s_{t-p})) + u_t \quad (6)$$

Basic Structure of the MS-VAR Model

The MS(m)-VAR(p) model for K endogenous variables X_t can be written as:

$$X_t = \partial(S_t) + \sum A_i(S_t) X_{t-i} + v_t, i = 1,..., p \quad (7)$$

where:

- X_t is a vector of endogenous variables.

- S_t is the regime (state) variable, which follows a Markov process and switches between m regimes.

- $A_i(S_t)$ are the regime-dependent coefficient matrices for the i-th lag.

- $\partial(S_t)$ is the regime-dependent intercept term.

- v_t is the vector of residuals, which follow a normal distribution with regime-dependent variance.

Regime Switching

The regime S_t follows a discrete Markov process, with transition probabilities P_{ij} determining the likelihood of switching between regimes:

$$P_{ij} = \Pr(S_t = j \mid S_{t-1} = i) \quad (8)$$

The transition probabilities form an m x m matrix P, where each row sums to 1.

Variance-Covariance Structure

The residuals v_t have a regime-dependent variance-covariance matrix:

$$\sum(S_t) = A_1(S_t)A_1(S_t)^T \quad (9)$$

This structure captures heteroskedasticity, allowing for periods of high and low volatility across different regimes

Regime-Dependent Impulse Response Functions (RDIRF)

One of the key advantages of MS-VAR is its ability to calculate regime-dependent impulse response functions (IRFs):

$$RDIRF_i = E(X_{t+h} \mid v_{t,} S_t = i) \quad (10)$$

This traces the expected paths of endogenous variables after a shock, conditional on the regime at time t.

To be specific, this study uses MSIH(2)-VAR(1) model to describe two financial stages. This specific model is set as follows. The MSIH(2)-VAR(1) model allows parameters to switch between two regimes—financial expansion and recession. Regimes switch based on probabilities, capturing how the financial cycle evolves over time. It can be represented as:

$$X_t = \partial(S_t) + A_1(S_t)X_{t-1} + v_t \quad (11)$$

Where:

- X_t is a vector of endogenous variables.

- $S_t \in \{1, 2\}$ represents the regime (1 for recession and 2 for expansion).

- $A_1(S_t)$ is the regime-dependent coefficient matrix for the first lag.

- $\partial(S_t)$ is the regime-dependent intercept.

- v_t represents residuals, which follow a normal distribution with regime-dependent variance $\sum(S_t)$.

The regime S_t follows a Markov process with transition probabilities:

$$P_{ij} = \Pr(S_t = j \mid S_{t-1} = i) \quad (12)$$

Estimation Approach of MSIH(2)-VAR(1)

The model is estimated using the Expectation-Maximization (EM) algorithm, which involves:

E-step: Computing the expected log-likelihood, given current parameter estimates.

M-step: Updating parameters to maximize the log-likelihood. This iterative process effectively handles the latent (unobserved) regime-switching component of the model.

Identification Strategy of MSIH(2)-VAR(1)

Lag Structure: The model uses lagged variables to capture dynamic relationships, identifying how shocks affect variables under different regimes.

Cholesky Decomposition: This is used to disentangle structural shocks from the residuals, helping identify the impact of specific shocks on variables like GDP and credit.

Regime-Dependent Impulse Response Functions (RDIRF) of MSIH(2)-VAR(1)

The RDIRF helps trace the path of variables after a shock, conditional on the regime. This reveals how the effects of shocks—such as interest rate changes—differ between financial expansion and recession.

Therefore, the FCI can be used as a regime-switching variable to represent the state of the financial cycle, with regime 1 indicating a financial boom and regime 2 indicating a financial recession. The MS-VAR model is then employed to study the differences in the effectiveness of the two macroeconomic policies under different financial conditions and use the EM (Expectation-Maximization) method to estimate the MS-VAR model.

3.5 Construct shadow rate model of China

According to Wu-xia's (2016) shadow rate model, this study build a model to calculate China's shadow rate as China has a ZLB period around 2015. First, this study apply an Affine Term Structure Model (ATSM), which is given by

$$y_t(\tau) = \beta_0(\tau) + \beta_1(\tau) X_t + \varepsilon_t \quad (13)$$

$y_t(\tau)$ is the yield of a bond with maturity τ

X_t represents latent factors

β s are coefficients

For China's shadow rate calculation, this study first use government bond yields (3-month, 6-month and 1-year) for a comprehensive yield curve. And use 3-month SHIBOR

as a reference short-term interest rate.

Next, build a 3-factor model X_t using three government bond yields to fit China's yield curve $X_t = (X_{1t,} X_{2t}, X_{3t})'$ (14) and set up a short-term interest rate equation: $i_t^* = \delta_0 + \delta' X_t$ (15)

Then, apply constraint $i_t = \max(i_t^*, 0)$ (16), reverse-calculate i* as the shadow rate.

Finally, use Kalman Filtering to extract latent factors and estimate shadow rate.

4. Results

4.1 Constructing FCI

Use the CIRF method to construct the FC Index of four countries. First, use the HP filter method to extract the cycle fluctuation of credit and HPI. Next, construct a var model and use 10th order intercept of impulse response as the weights to build FCI.



Figure 1 UK, CHINA, US and EU Financial Condition Index

The analysis of FCIs across these four regions highlights distinct financial dynamics shaped by local economic policies, global financial crises, and region-specific challenges. Each region's response to economic stressors varies depending on the actions of their

respective central banks, financial market structures, and macroeconomic conditions. This comparison offers valuable insights into the resilience and adaptability of financial conditions across the UK, China, US and the Eurozone in the face of different economic shocks.

The UK and US FCIs exhibit more pronounced volatility in response to financial crises compared to the relatively steady movements of the EU and China. This reflects the differences in financial market structures and the role of central banks in managing crises. The COVID-19 pandemic had a broadly similar impact across all regions, with significant tightening of financial conditions followed by easing as central banks implemented monetary stimulus measures. However, the extent and nature of these policy responses varied, with the UK and US showing more aggressive easing measures. The EU's financial conditions were affected not only by global crises but also by unique challenges such as the sovereign debt crisis and geopolitical risks. Meanwhile, China's financial conditions were largely influenced by domestic policy shifts, regulatory interventions, and its ability to maintain strict financial controls.

In the United Kingdom, the FCI presents notable fluctuations throughout the period, especially during the global financial crisis of 2008 and the recent COVID-19 pandemic. Before the 2008 financial crisis, the FCI reached a significant peak, indicating tight financial conditions, followed by a sharp decline in 2009. This reflects the Bank of England's aggressive monetary policy measures to counter the economic contraction. From 2010 to 2016, the FCI remained relatively stable, but the Brexit referendum in 2016 introduced new volatility, tightening conditions due to heightened market uncertainty. The impact of the COVID-19 pandemic is also clearly visible, with a sharp spike around 2020, followed by a rapid drop, indicating the Bank of England's efforts to support the economy. These measures, including rate cuts and asset purchases, helped ease financial conditions during the recovery.

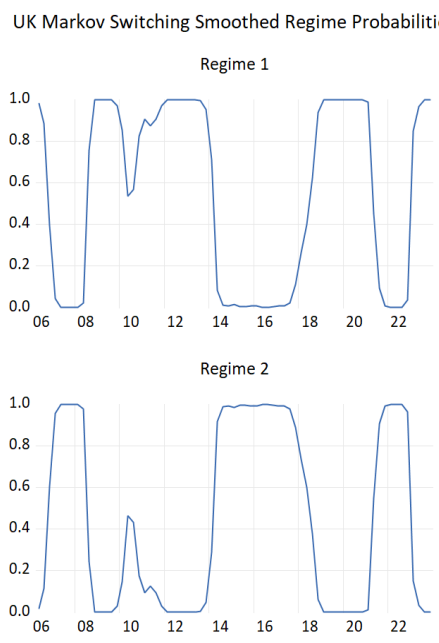
China's FCI displays lower volatility compared to other regions, with key movements reflecting shifts in the country's regulatory and policy landscape. During the 2008 global financial crisis, China's FCI experienced only moderate changes, as the country implemented a substantial stimulus package and maintained strict financial controls, which helped insulate its economy. The significant dip around 2015-2016 corresponds to the stock market crash in China, followed by government intervention to stabilize financial markets and limit capital outflows. Around 2018, the FCI saw another rise, coinciding with the U.S.-China trade war, which increased market uncertainty and tightened financial conditions. The post-2020 period shows some easing, reflecting policy efforts to support economic recovery after the COVID-19 pandemic, such as increased credit supply and fiscal support measures.

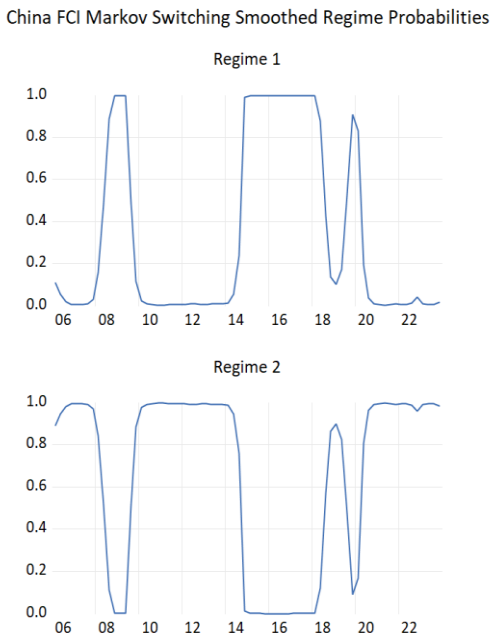
The Financial Conditions Index for the United States mirrors major economic cycles, particularly influenced by crises and monetary policy decisions. The 2008 financial crisis caused a significant peak in the FCI, followed by a steep decline as the Federal Reserve intervened with quantitative easing and other monetary easing measures. The FCI remained relatively stable during the 2010s, though tightening occurred between 2015 and 2018 as the Fed gradually raised interest rates to normalize monetary policy. In 2020, the COVID-19

pandemic led to a sudden spike in the FCI, reflecting tightening financial conditions as economic activity slowed. However, the subsequent relaxation was swift, as the Federal Reserve introduced unprecedented fiscal and monetary support, including rate cuts and liquidity injections. Recent trends in 2022 show tightening conditions again, likely due to rising inflation and the Fed's subsequent rate hikes.

The EU's Financial Conditions Index depicts fluctuations driven by both global and region-specific challenges. During the 2008 financial crisis, the EU's FCI tightened significantly, followed by a relaxation as the European Central Bank (ECB) introduced various accommodative measures. The period from 2010 to 2012 saw renewed tightening, linked to the Eurozone sovereign debt crisis, which led to financial instability in countries like Greece, Spain, and Italy. Financial conditions eased considerably after 2015, supported by the ECB's quantitative easing program, which aimed to stimulate growth and mitigate deflation risks. The Brexit referendum in 2016 also contributed to uncertainty, which affected the financial conditions within the EU. During the COVID-19 pandemic, the FCI spiked sharply as financial markets faced increased risk and liquidity concerns. This was followed by a significant easing as the ECB implemented broad monetary support programs. The steep rise and decline during 2022 to 2023 reflect the impact of the energy crisis, supply chain disruptions, and geopolitical tensions related to the Russia-Ukraine conflict.

Next, use MS-VAR to transfer these FCI and identify financial stages during 2006 to 2023. By calculating the maximum likelihood function iteratively, the smooth probability of the two-region transition is calculated as shown in the figure. Regime 1 refers to recession and Regime 2 refers to prosperity.





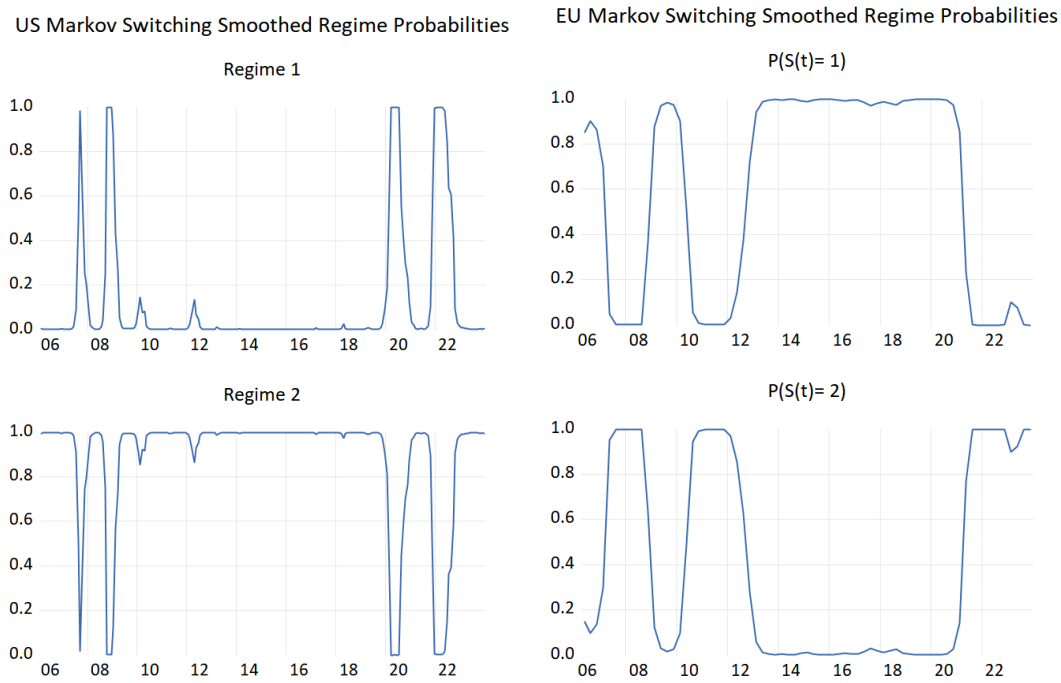


Figure 2 Markov Switching Smoothed Probabilities of FCI of UK, CHINA, US and EU

The UK's smoothed regime probabilities indicate that Regime 1, representing the recession stage, has an expected duration of approximately 11.42 quarters, with a transition probability of 0.912. This suggests that once the UK economy enters a recessionary phase, it tends to remain in this state for a considerable period before transitioning to another regime. The high probability reflects a notable persistence of economic contraction during recession periods. In contrast, Regime 2, which represents the expansion stage, has an expected duration of about 7.90 quarters, with a transition probability of 0.873. This indicates that expansions in the UK also tend to persist but for a slightly shorter duration compared to recessions. These regime durations reveal that the UK economy experiences well-defined cycles of extended recession phases, followed by significant but somewhat shorter growth phases, highlighting the cyclical and persistent nature of both recession and expansion stages.

China’s smoothed probabilities suggest that Regime 1(recession) has an expected duration of approximately 7.31 quarters, with a transition probability of around 0.863. This implies that when the Chinese economy enters a recessionary phase, it tends to remain in that state for about 29 months on average before transitioning out. On the other hand, Regime 2 (prosperity) has a longer expected duration of about 16.48 quarters, with a transition probability of around 0.939. This indicates that periods of financial booms in China tend to last longer than recessions.

The US chart indicates that Regime 1, representing the expansion stage, has an expected duration of approximately 16.62 quarters, with a transition probability of 0.984. This suggests that once the US economy enters a recessionary phase, it remains in this state for a significantly extended period, reflecting a high level of persistence in economic contractions.

On the other hand, Regime 2, representing the recession stage, has an expected duration of about 16.10 quarters, with a transition probability of 0.938. This indicates that, while expansion periods are shorter compared to recessions, they are still relatively persistent, suggesting that once the economy enters an expansion phase, it has a strong tendency to sustain growth. These regime probabilities illustrate the pronounced cyclical behaviour of the US economy, characterized by prolonged recessions and moderately lengthy periods of expansion.

The Eurozone's smoothed regime probabilities indicate that Regime 1, representing the recession stage, has an expected duration of approximately 14.70 quarters, with a transition probability of 0.932. This suggests that once the Eurozone enters a recessionary state, it tends to persist in that phase for a considerable period before transitioning to an expansion phase, indicating a strong persistence of economic downturns. Regime 2, representing the expansion stage, has an expected duration of about 10.39 quarters, with a transition probability of 0.904. This indicates that expansion phases, while slightly shorter in duration compared to recessions, are still relatively stable, with the economy demonstrating a notable ability to sustain growth periods.

4.2 MS-VAR Model results

In this research, the quarter real economic growth rate is selected as the dependent variable, denoted by y. The financial conditions index (FCI) is utilized to describe the state of the financial cycle.

Furthermore, this paper picks Counter cyclical Capital Buffer related variables in four countries and areas as their central banks implement similar macro-prudential policies such as setting ccyb rate. This study constructs an MSVAR model by selecting distinct macro-prudential policy proxy indicators for each country, taking into account data availability and the varying priorities of their respective central banks. Every variable y, r and money supply indicators (M2, M3, M4) has been log-differenced. According to Log-likelihood value and AIC, this paper use MSIH(2)-VAR(1) Model. The MSIH(2)-VAR(1) model is a Markov Switching Intercept Heteroskedastic Vector Autoregression model with two regimes and one lag. This model allows for changes in both the intercept and variance of the system, depending on the regime, which is governed by a Markov process.

4.2.1 China

As for China, the authorities do not set ccyb ratio but gradually implement related policies. This paper selects, for China, the Core Tier 1 Capital Adequacy Ratio of commercial banks, the liquidity ratio of commercial banks, and the excess reserve requirement ratio to represent macro-prudential policies from three dimensions: countercyclical capital regulation policy, liquidity regulation policy, and dynamic reserve policy. Table 5 shows variables and their symbols for China.

Table 2: Variable Descriptions for China

Variable Name	Description	Symbol	Original Indicator
Economic Growth Rate	Quarterly GDP	y	GDP
Financial Cycle Condition	Financial Cycle Index	fci	Financial Cycle Index
Money Supply	Monetary Policy	m2	Broad Money Supply (M2)
Interest Rate	Monetary Policy	r	7-Day Interbank Repo Rate
Liquidity Ratio	Macroprudential Policy	lr	Commercial Bank Liquidity Ratio
Excess Reserve Requirement	Macroprudential Policy	err	Financial Institution Excess Reserve Requirement
Core Tier 1 Capital Adequacy Ratio	Macroprudential Policy	ctcar	Commercial Bank Core Tier 1 Capital Adequacy Ratio
Consumer Price Index	Quarterly CPI	CPI	Consumer Price Index
Shadow rate	Monetary Policy	r_s	Shadow rate

The stationarity of the data was tested, and the results are shown in Table 1 in appendix. All variables except economic growth are stationary at the 1% significance level, while the economic growth variable is stationary at the 5% significance level. Thus, this paper can use lag1 in the MS-VAR model.

As shown in the Table below, the intercept differences for the FCI variable across different regimes are larger relative to those for other variables, indicating that the different regimes primarily reflect changes in the state of the financial cycle. Specifically, Regime 1 corresponds to a period of financial expansion, while Regime 2 corresponds to a period of financial tightening. Additionally, the standard error for the FCI variable in Regime 2 is significantly larger than that in Regime 1, suggesting that financial conditions are more volatile during Regime 2.

Table 3: MS-VAR Model Estimation Results for China

Variable	fci	m2	r	lr	err	ctcar	y
Const(regime1)	0.172845*	0.195902***	0.070971***	0.193961***	-0.065953***	0.03698***	1.307141
Const(regime2)	0.174854***	0.213895***	0.073021***	0.20083***	-0.059677***	0.037571***	1.349017

fci_{t-1}	0.865304***	-0.116483***	0.014962***	-0.024534***	-0.028284***	-0.0111***	-0.337465
$m2_{t-1}$	-0.078365***	0.70258***	-0.068846***	-0.216928***	0.111182***	-0.022355***	-0.575913
r_{t-1}	-1.309195***	-0.603184***	0.484182***	-0.494976***	0.218854***	0.025927***	-2.136567
lr_{t-1}	-0.051449**	-0.085152***	-0.053418***	0.940141***	-0.018058***	-0.007041***	-0.592017
err_{t-1}	1.389872***	0.507576***	0.063139***	-0.21235***	-0.375004***	-0.276325***	-14.965376
$ctacr_{t-1}$	-1.198205***	-1.175667***	-0.217431***	-1.133482***	0.728582***	0.744865***	-5.608383
y_{t-1}	-0.024456	-0.011243	0.003901	-0.007269	0.004257	0.006716***	-0.461421
SE (regime1)	0.088454	0.018174	0.004645	0.008703	0.005218	0.002109	0.073035
SE (regime2)	0.021443	0.008534	0.003501	0.011275	0.003162	0.001263	0.075864
Log Likelihood	1401.4121						
AIC	-43.4038						

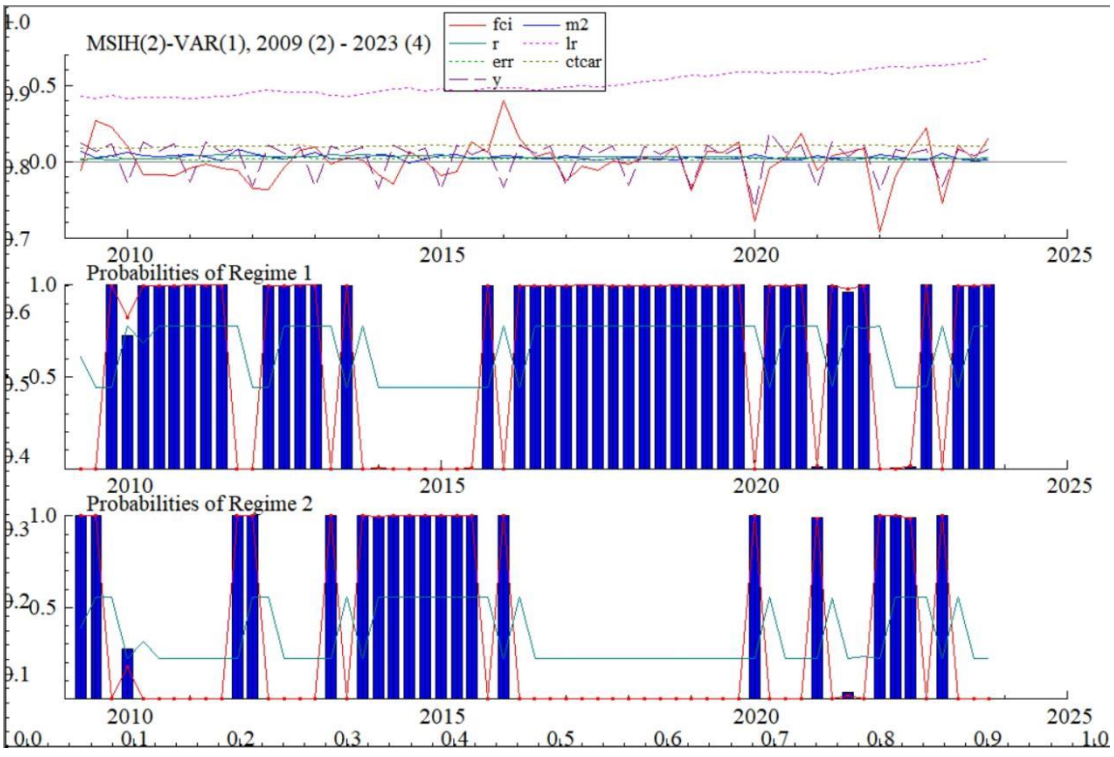


Figure 3. Probabilities of two Regimes of China

Due to the availability of several macro policy data for China beginning in 2009 and China's increased focus on these prudential indicators since that year, the MS-VAR model regression starts from 2009. The figure demonstrates that regime shifts between the two systems occur relatively frequently, and the overall fluctuations are consistent with the variations characteristic of financial cycles.

Table 4: MS-VAR Model Regime1 Correlation Matrix for China

Variable	fci	m2	r	lr	err	ctcar	y
fci	1.0000	-0.0709	-0.1068	0.0354	0.6314	-0.1349	0.4511
m2	-0.0709	1.0000	0.5288	-0.1155	-0.3162	-0.5094	-0.6460
r	-0.1068	0.5288	1.0000	-0.2094	-0.4080	-0.3553	-0.4962
lr	0.0354	-0.1155	-0.2094	1.0000	0.4484	0.5014	0.2537
err	0.6314	-0.3162	-0.4080	0.4484	1.0000	0.3586	0.7292
ctcar	-0.1349	-0.5094	-0.3553	0.5014	0.3586	1.0000	0.5241
y	0.4511	-0.6460	-0.4962	0.2537	0.7292	0.5241	1.0000

Table 5: MS-VAR Model Regime2 Correlation Matrix for China

Variable	fci	m2	r	lr	err	ctcar	y
fci	1.0000	-0.5009	-0.0655	-0.3327	-0.3394	0.2211	0.3634
m2	-0.5009	1.0000	-0.4100	0.3701	-0.1503	-0.7474	-0.4018
r	-0.0655	-0.4100	1.0000	0.0788	0.2032	0.3951	-0.0713
lr	-0.3327	0.3701	0.0788	1.0000	-0.5615	-0.3304	-0.4542
err	-0.3394	-0.1503	0.2032	-0.5615	1.0000	0.1487	0.0846
ctcar	0.2211	-0.7474	0.3951	-0.3304	0.1487	1.0000	-0.0481
y	0.3634	-0.4018	-0.0713	-0.4542	0.0846	-0.0481	1.0000

As an important variable for regime shifts, fci shows significant differences in the performance of various variables between financial expansion and financial contraction, indicating that the effectiveness of the dual-pillar policy framework varies across different phases of the financial cycle.

Under the financial tightening regime (Regime 1), the FCI exhibits a negative correlation of -0.589 with GDP growth (y), suggesting that tighter financial conditions coincide with lower economic output. This finding aligns with monetary theory, wherein higher interest rates—seen in the -0.617 correlation between r and y—dampen investment and consumption, thereby constraining growth. Interestingly, M2 has a positive correlation of 0.346 with GDP growth, implying that broad monetary aggregates still provide some liquidity that may partially counteract the contractionary effects of elevated rates.

In the financial expansion regime (Regime 2), while M2 remains strongly and negatively correlated (-0.583) with interest rates, consistent with classic expansionary dynamics, its association with GDP growth is marginally negative (-0.055)—signaling that surges in M2 may not necessarily spur real output if liquidity is channeled into asset markets or speculative ventures. As for macro-prudential variables, their correlations with monetary variables are different between two regimes. For instance, lr is positive with m2 and r in regime1, but negative with m2 and r in regime2. This implies the synergistic effect of monetary and macro-prudential is different between two regimes. Thus, policy maker needs to notice the weakening effect of macro-prudential policy on monetary policy in financial expansion stage.

Overall, these numeric correlations underscore the multifaceted nature of monetary transmission in China's evolving financial landscape, showing that the interplay of money supply, interest rates, and prudential requirements can yield complex real-economic outcomes.

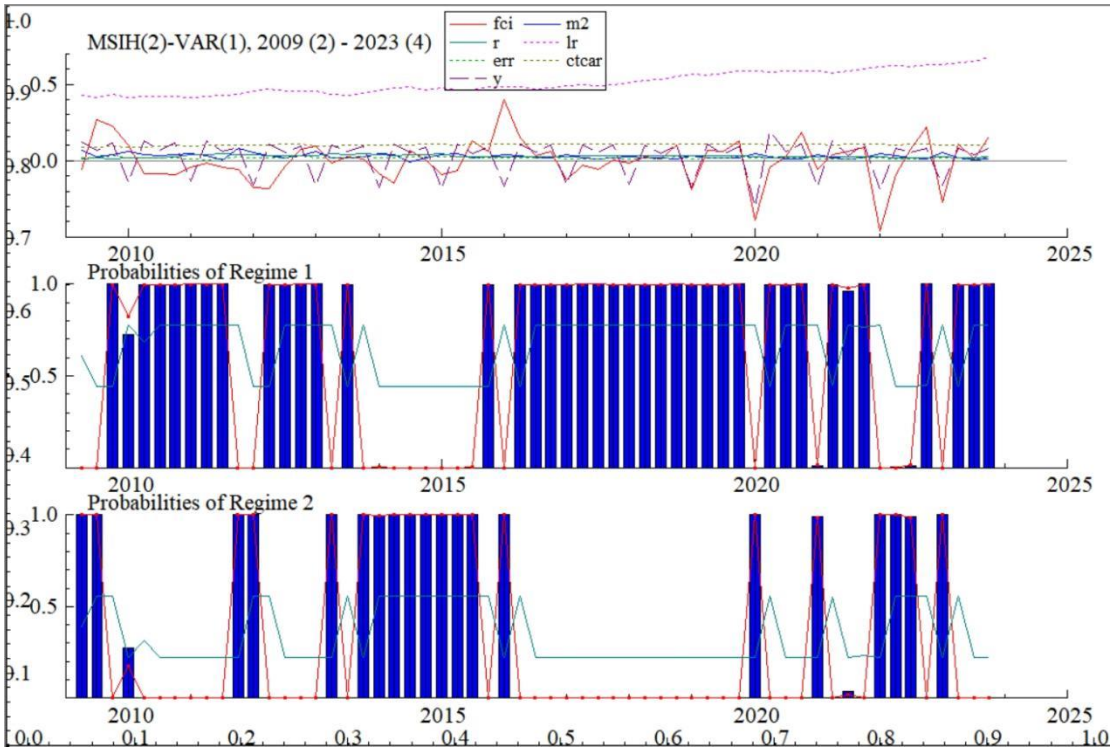


Figure 3. Probabilities of two Regimes of China

Due to the availability of several macro policy data for China beginning in 2009 and China's increased focus on these prudential indicators since that year, the MS-VAR model regression starts from 2009. The figure demonstrates the regime shifts between the two systems occur relatively frequently, and the overall fluctuations are consistent with the variations characteristic of financial cycles. Results in Figure 3 indicate that the financial system tends to remain in the contractionary phase (Regime 1) for longer periods, with an average duration of 16 quarters, whereas the expansion phase (Regime 2) occurs more frequently but lasts for shorter periods, averaging 8.93 quarters, highlighting the need for more frequent policy adjustments during financial expansions and a focus on long-term stability during contractions.

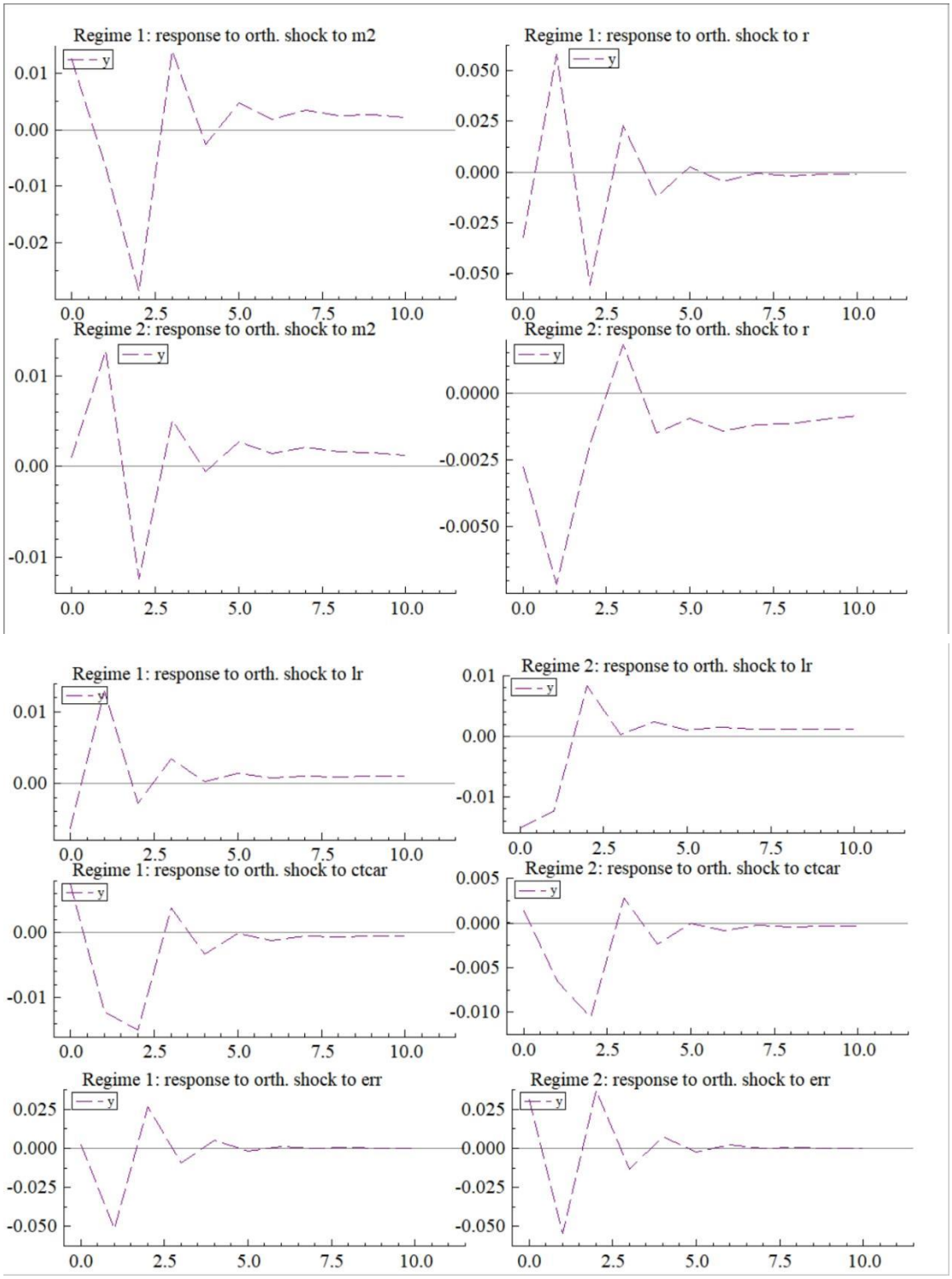


Figure 4. China Impulse Responses of output

Through figure 4, it can be more intuitively to analyze how output reacts differently across various financial phases when both types of macro policies coexist and one kind of policy is implemented. M2 shocks produce a positive but then more pronounced downturn on output in contraction stage (Regime 1), whereas the same shocks generate milder or shorter - lived dips under expansionary conditions. The response steps are slightly different, but both line reaches the minimum after 2 steps and reaches cloth to zero after 5 steps. Likewise, interest rate increases inflict a steeper and more sustained negative impact on output in

Regime 1, but have a relatively moderate effect in Regime 2. This indicates that during the financial contraction phase, the two types of monetary policy effects fluctuate greatly However, as for the macro-prudential variables (lr, ctcar, err), their shocks on output have similar response intensity and response steps. This implies monetary policies have the main effect in dual-pillar policy framework. Therefore, the central bank of China can mainly increase M2 and lower r to rise output in two stages.

Dual-pillar Policy’ s Impact on Inflation of China

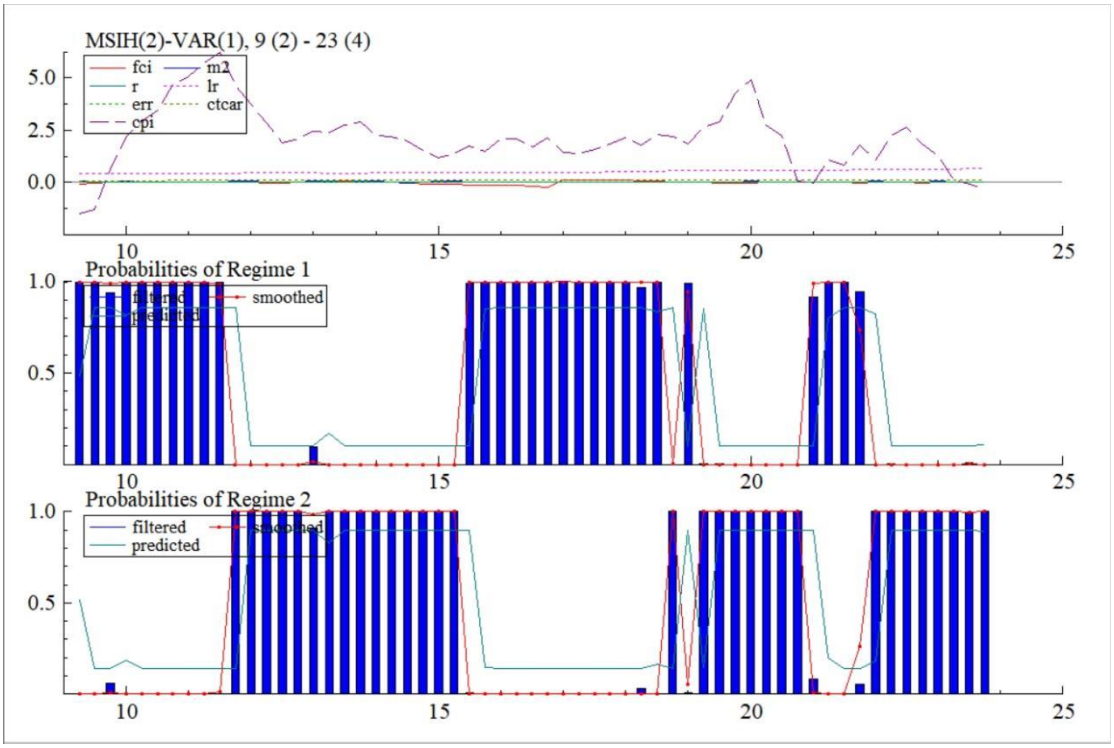


Figure 5. China Regime probabilities under CPI

From figure 5, it can be seen the allocation of two regimes are similar, because fci plays the leading role in regime decision.

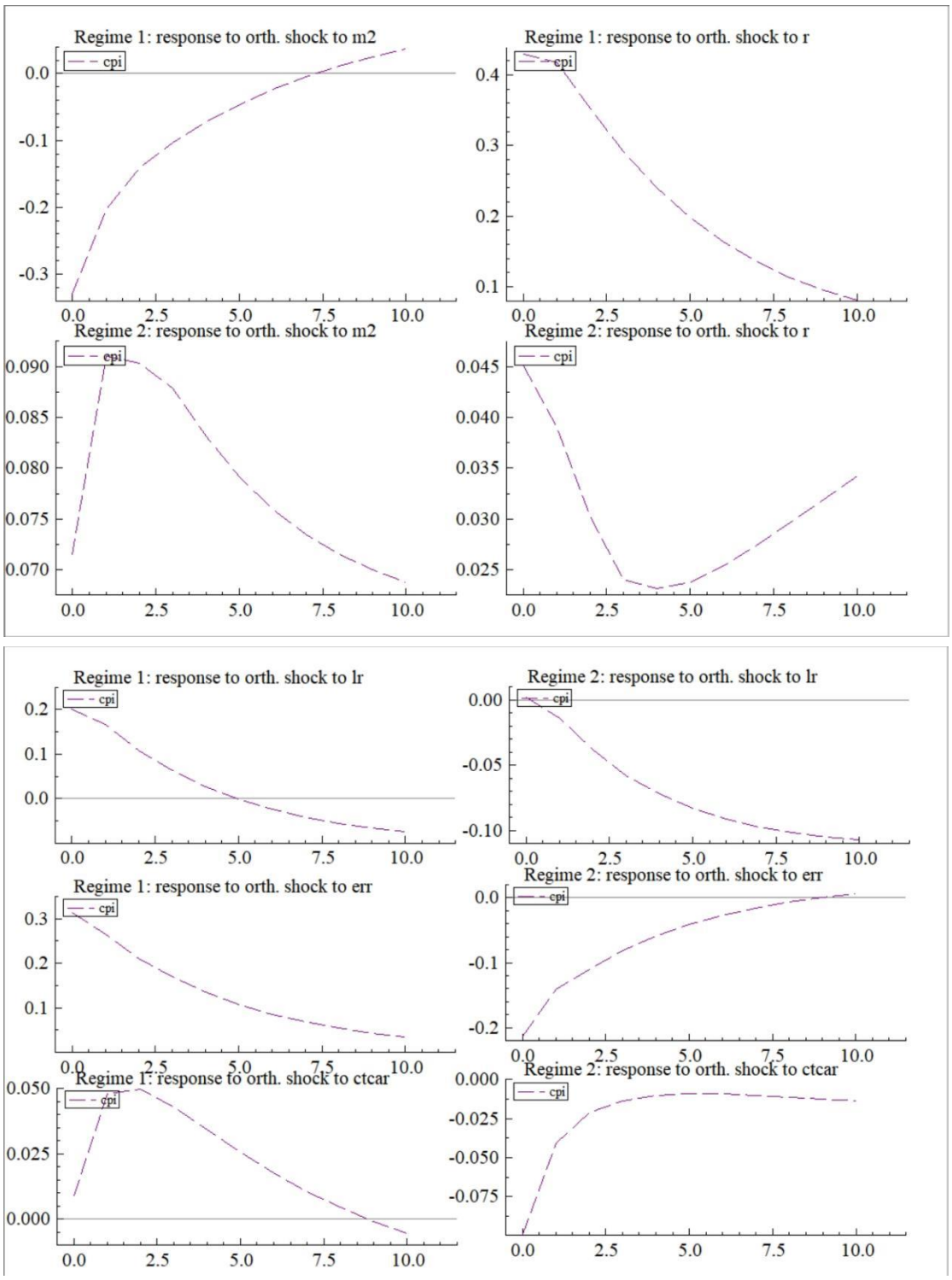


Figure 6. China Impulse Responses of Inflation

Figure 6 first presents the impulse responses of CPI to two types of monetary policy shocks—one quantity-based (M2) and one price-based (interest rate)—across Regime 1 (financial tightening) and Regime 2 (financial expansion). Under the M2 shock, Regime 1 displays a pronounced negative path for CPI: immediately after the shock, CPI dives sharply below its baseline (reaching around -0.3 by the second or third period), then gradually rebounds toward zero by the tenth period. By contrast, in Regime 2, CPI begins at a positive level (roughly 0.09), then decays more gently over time, implying that when liquidity is

already abundant, any additional monetary stimulus elevates inflation at first but tapers off in a smoother manner. The interest-rate shock generates the opposite initial response. In Regime 1, CPI starts at a high positive level of about 0.4 and monotonically declines back to baseline over 10 periods, indicating that a rate increase in a tight environment initially boosts price levels—perhaps via cost-push or expectation channels—before disinflationary forces dominate. Meanwhile, Regime 2's CPI reaction is less pronounced: it hovers around 0.045, then dips below 0.025 at around the third period, and eventually settles slightly above 0.03, suggesting that expansionary conditions dampen the rate shock's immediate pass-through but still yield a net decline in inflation.

Figure 6 then depicts how CPI responds to shocks from three macro-prudential tools—liquidity ratio (lr), excess reserve requirement (err), and capital adequacy ratio (ctcar)—under two distinct regimes. Examining the lr shock first, Regime 1 displays an initially high positive CPI response (around 0.2) that steadily declines to zero by roughly the tenth period, indicating that stricter liquidity constraints gradually reduce price pressures. In contrast, Regime 2 begins near zero and moves deeper into negative territory (about -0.1) before converging, suggesting a stronger disinflationary effect when financial conditions are looser overall. Next, the err shock in Regime 1 prompts CPI to start at approximately 0.3 and decline steadily, highlighting a pronounced though smooth path toward disinflation, whereas Regime 2 exhibits an initially negative CPI level (below -0.2) that rebounds upward over time, reflecting a more abrupt initial dip. Finally, the ctcar shock yields a moderate CPI uptick in Regime 1—peaking near 0.05—followed by a drop below zero, while Regime 2's CPI climbs to about -0.075 (relative to its negative baseline) and eventually levels off. Thus, whereas Regime 1's overall responses begin more positively and diminish in a steady downward arc, Regime 2 tends to open with a negative or near-zero CPI response that deepens, then rebounds. In short, heightened macro-prudential constraints (lr, err, ctcar) exert different price effects depending on whether the system is in a tighter regime (which starts higher and tapers down) or an expansionary one (which often begins lower and recovers), underscoring how each tool's influence on inflation hinges on the broader financial environment.

This study does not analyse China's non-performing loan rate and unemployment rate because there is no macro non-performing rate and unemployment rate is controversy whether it reflects real condition.

`

4.2.2 UK

For the UK, the selected macro-prudential policy proxy variables are all derived from the Bank of England's variables related to the CCyB ratio. These are variables that the Bank of England prioritizes when overseeing financial stability, and other variables with insufficient data were excluded to observe the long-term effects. Table 7 below shows variables and their symbols for UK. The three-month LIBOR is used here because other frequencies have ceased to be reported.

Table 7: Variable Descriptions for UK

Variable Name	Description	Symbol	Original Indicator
Economic Growth Rate	Quarterly GDP Growth Rate	y	GDP
Financial Cycle Condition	Financial Cycle Index	fci	Financial Cycle Index
Money Supply	Monetary Policy	M4	Broad Money Supply (M4)
Interest Rate	Monetary Policy	r	3-month LIBOR Rate
Credit-to-GDP gap	Macroprudential Policy	ctg	Credit-to-GDP gap
CET1 Capital Ratio	Macroprudential Policy	cet	Commercial Bank CET1 Capital Ratio
Non-Performing Loans rate	Non-Performing Loans rate	npl	Commercial Bank Non-Performing Loan Ratio
Consumer price index	Quarterly CPI data	cpi	Consumer price index
Unemployment rate	Quarterly unemployment rate	uep	Unemployment rate
Shadow rate	Monetary Policy	r_s	Shadow rate

Table 8 shows the results of MS-VAR for UK. Here the Log-likelihood is the largest and AIC is the lowest among all MS-VAR models.

Table 8: MS-VAR Model Estimation Results for UK

Variable	fci	M4	r	ctg	cet	y	Variable
Const(regime1)	0.127605**	-0.009579	-0.431399***	0.008644	0.014725***	0.023790	Const(regime1)
Const(regime2)	0.105122	0.002965	-0.303616	0.006950	0.015357***	0.042287***	Const(regime2)
fci_{t-1}	0.045426	-0.064066	0.251951	-0.051669	-0.005989	0.238136	fci_{t-1}
$M4_{t-1}$	2.088289***	-0.627406	2.998584***	-0.868911	-0.033257	3.261478***	$M4_{t-1}$
r_{t-1}	0.093532	-0.013583	0.494941	-0.018938	0.001091	-0.012173	r_{t-1}
ctg_{t-1}	0.115325*	-0.011476	-0.327359	0.979952***	0.001250	-0.182608	ctg_{t-1}

cet_{t-1}	-2.311578***	0.119575	6.037581***	-0.031470	0.745111***	-0.667061	cet_{t-1}
y_{t-1}	0.475862	-0.076554	3.085547***	-0.124306	0.007828	-0.192143	y_{t-1}
SE (regime1)	0.086665	0.010105	0.101169	0.014950	0.001727	0.040999	SE (regime1)
SE (regime2)	0.195882	0.020425	0.505340	0.017921	0.002190	0.027176	SE (regime2)
Variable	fci	M4	r	ctg	cet	y	Variable
Log Likelihood	1151.7029						
AIC	-34.3568						

Table 9: MS-VAR Model Regime1 Correlation Matrix for UK

Variable	fci	M4	r	ctg	cet	y
fci	1.0000	-0.7435	0.6022	-0.4673	0.0473	0.4990
M4	-0.7435	1.0000	-0.6362	0.5928	0.0736	-0.7529
r	0.6022	-0.6362	1.0000	-0.3996	-0.1996	0.5247
ctg	-0.4673	0.5928	-0.3996	1.0000	-0.2468	-0.6681
cet	0.0473	0.0736	-0.1996	-0.2468	1.0000	0.0473
y	0.4990	-0.7529	0.5247	-0.6681	0.0473	1.0000

Table 10: MS-VAR Model Regime2 Correlation Matrix for UK

Variable	fci	M4	r	ctg	cet	y
fci	1.0000	-0.9769	-0.0963	-0.1557	0.3638	0.1707
M4	-0.9769	1.0000	0.0222	0.1521	-0.3090	-0.0708
r	-0.0963	0.0222	1.0000	-0.4042	0.1896	-0.0023
ctg	-0.1557	0.1521	-0.4042	1.0000	-0.0129	-0.4476
cet	0.3638	-0.3090	0.1896	-0.0129	1.0000	0.2655
y	0.1707	-0.0708	-0.0023	-0.4476	0.2655	1.0000

Table 9 and 10 reveal how the dual-pillar policy framework produces varying outcomes under financial expansion (Regime 1) versus financial contraction (Regime 2). During expansion, increasing money supply (M4) and a widening credit gap (ctg) both correlate negatively with GDP growth, suggesting that excessive liquidity and lending can undermine performance. Here, in the UK context, a negative correlation between M4 and GDP growth may be confused. It can arise from several reasons. First, expansions in M4 do not necessarily funnel into real-sector investment, as significant portions of newly created liquidity often flow into speculative or non-productive channels—fueling financial bubbles rather than supporting output. Second, the UK's role as a major international financial center means that a substantial share of money supply may reflect cross-border transactions or deposits, weakening its direct link to domestic growth. Finally, monetary overshoots frequently precede an eventual slowdown, so excess liquidity at one stage can coincide with sluggish or even negative growth later on.

Meanwhile, higher interest rates appear linked to stronger growth, possibly reflecting rate hikes spurred by already-buoyant conditions. In contrast, Regime 2 sees weaker negative links between M4 and GDP, and a near-zero correlation between interest rates and growth, indicating more muted monetary policy effects in downturns. For macro-prudential variables, the CET1 capital ratio emerges as more positively correlated with GDP during contraction, highlighting how stronger bank capitalization supports recovery and financial resilience.

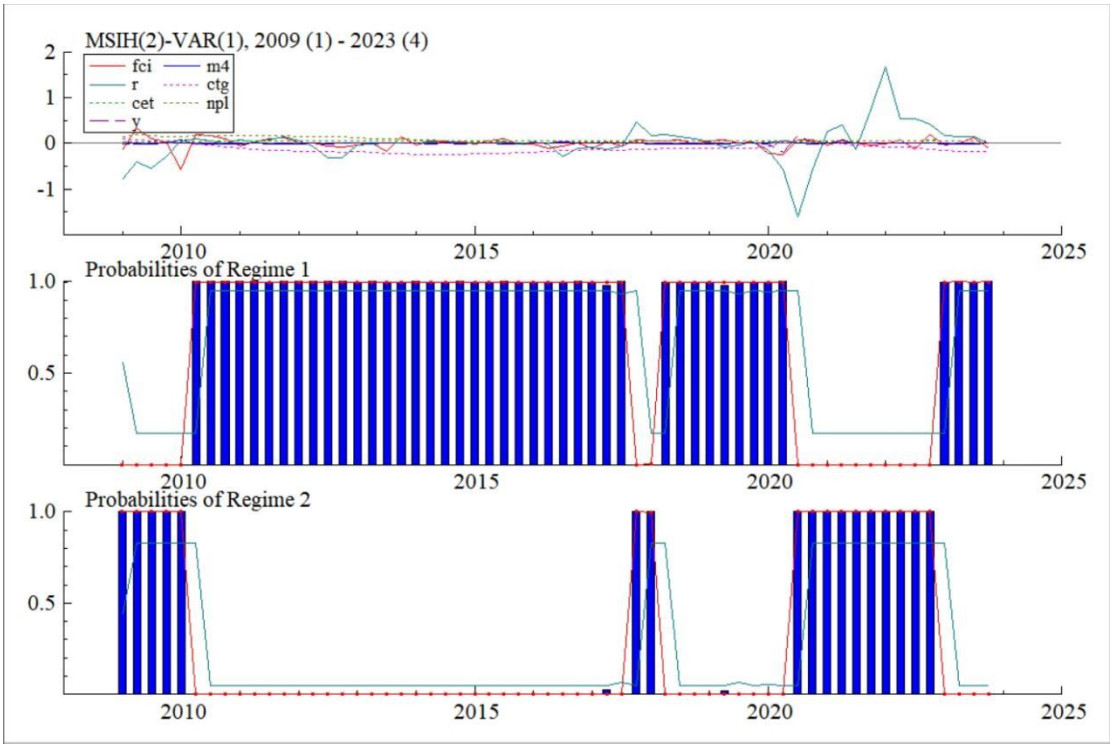


Figure 7. Regime Probabilities Results of UK

The Figure 7, transition probability matrix and regime properties for the UK suggest that the financial system tends to remain in Regime 1 (financial expansion) for much longer periods, with an average duration of 15.2 quarters, whereas Regime 2 (financial contraction) is less frequent, with an average duration of only 4.37 quarters, indicating a strong stability during financial expansion and shorter, less frequent periods of contraction. The figure also shows due to start dates of variables, it has less period than fci this paper constructed before.

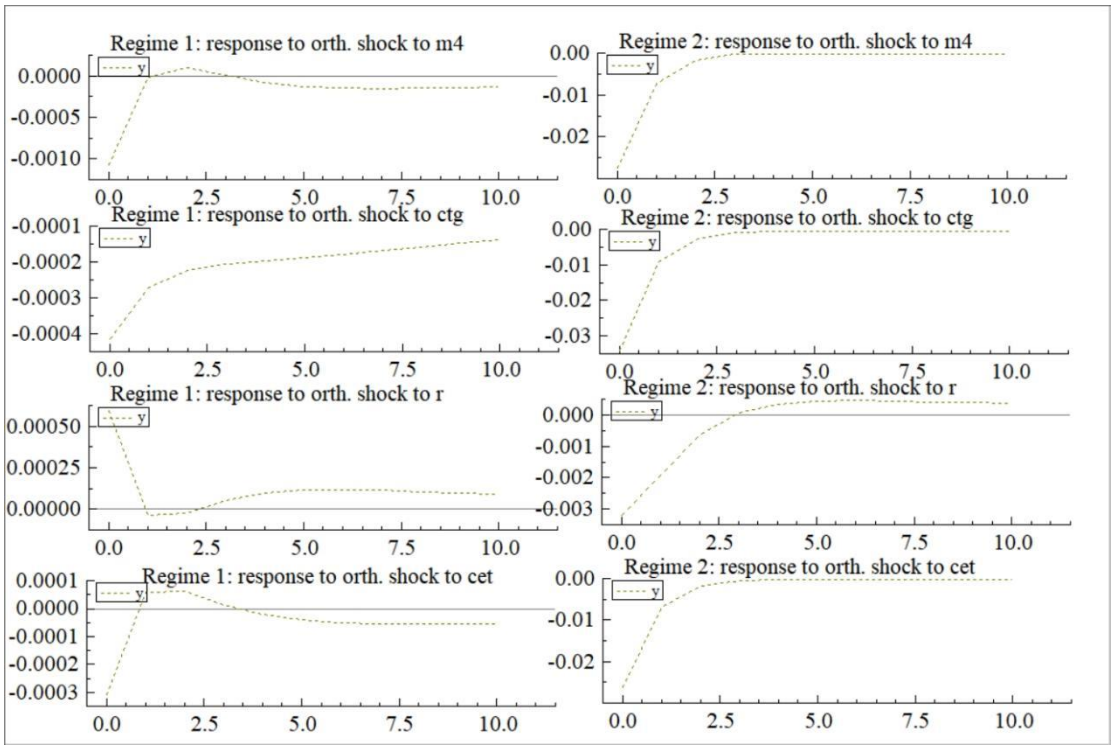


Figure 8. UK Impulse Responses of output to shock of other variables

Based on figure 8, in Regime 1 (Growth Phase), shocks to M4, r and two macro-prudential measures (Credit to GDP Gap, CET1 Ratio) produce minor or slightly negative effects on GDP growth, indicating that additional liquidity, rise interest rates, or stricter bank capitalization have limited extra stimulus when the economy is already robust. By contrast, in Regime 2 (Contraction Phase), these same shocks elicit more pronounced and persistent negative responses, suggesting that during downturns, greater money supply, interest-rate rise, and tighter macro-prudential conditions may unintentionally deepen the slowdown. Overall, these results imply that in a growth environment, monetary and macro-prudential policy adjustments offer relatively modest benefits, whereas in a contraction, they risk exacerbating weak demand and dampened confidence.

These results imply that the Bank of England should dynamically adjust policies based on the financial cycle. During expansion phases, tighten macro-prudential measures, such as increasing CET1 capital ratios and managing the Credit-to-GDP gap, to curb excessive risk-taking while avoiding reliance on interest rate hikes or money supply expansion (M4), as their benefits are limited. During contraction phases, adopt coordinated monetary easing and macro-prudential loosening strategies, such as lowering liquidity requirements or moderately adjusting CET1 ratios, to support credit growth and stabilize the economy. Additionally, use expansion periods to build financial buffers and strengthen the banking sector’ s resilience against future downturns.

Dual-pillar policy’s Impact on inflation of UK

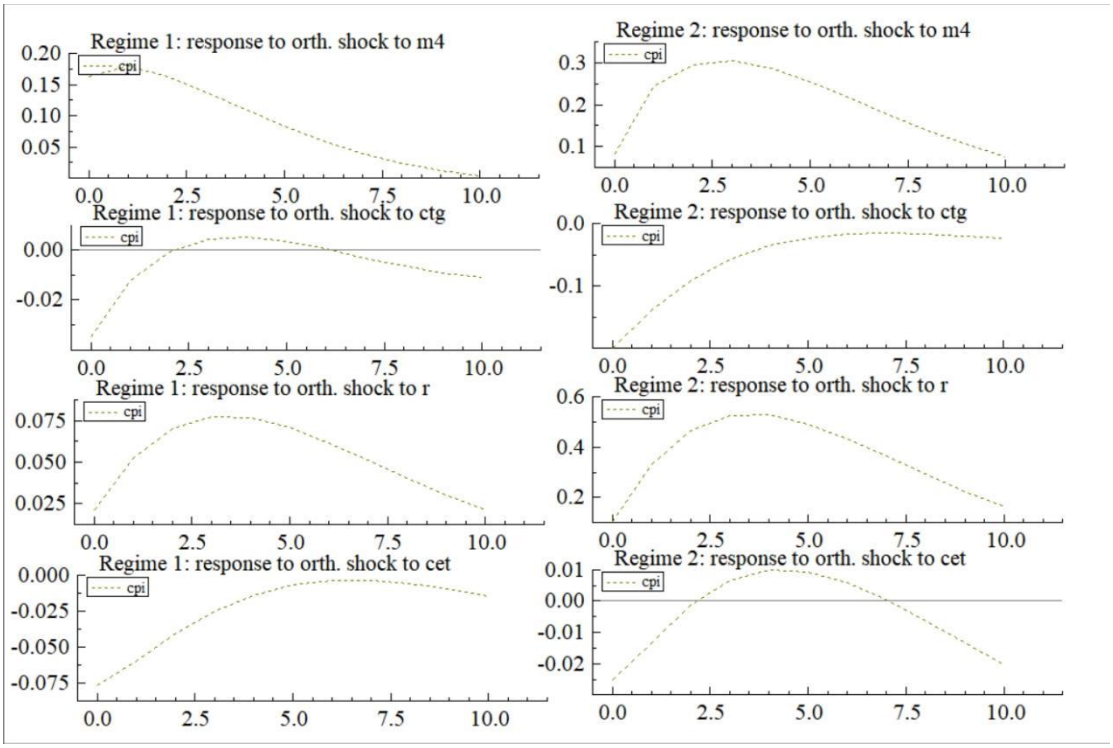


Figure 9. UK Impulse Responses of cpi to shocks of other variables

This study also focus on how dual-pillar policy's effect on other key factors including inflation, unemployment rate and non-performing loan. As for monetary variables, in Regime 1 (Growth Phase), a shock to broad M4 results in a significant and positive increase in inflation, with the effect peaking at around step 3 before gradually declining toward zero by step 10. This suggests that during periods of economic growth, an increase in the money supply exerts considerable inflationary pressure, which aligns with the idea that excess liquidity stimulates aggregate demand, leading to rising prices. In Regime 2 (Contraction Phase), the response to an M4 shock is even more pronounced, with a peak that is higher and more sustained compared to Regime 1. The inflation response reaches its maximum around step 4 and then slowly decreases. This suggests that during economic contractions, increased money supply has an even stronger inflationary effect, likely because the additional liquidity helps to revive weakened demand, thus pushing up prices more significantly than during expansions.

The interest rate (r) shock affects inflation differently across the two regimes. In Regime 1, an interest rate shock leads to a slight initial increase in CPI, peaking around step 3, possibly due to initial price adjustments or delayed monetary policy transmission. However, the effect turns negative after step 5 as higher interest rates suppress borrowing and spending, ultimately curbing inflation. In Regime 2, the response to an interest rate shock is considerably stronger and more immediate. The peak negative effect on CPI occurs around step 4 to 5, reflecting the heightened sensitivity of inflation to monetary tightening during economic downturns when demand is already weak.

As for Macro-prudential variables, in Regime 1, a shock to the credit gap initially leads to a small negative effect on CPI, which then turns positive and peaks around step 3 before declining toward zero. This indicates that during growth periods, an increase in the credit gap might initially signal an overheating of credit markets, slightly suppressing inflation, but eventually supports inflation by fostering greater spending. In Regime 2, the response is more straightforwardly positive, with the peak impact occurring around step 3, indicating that during contractions, an increase in the credit gap supports inflation as increased credit availability helps stimulate economic activity and demand.

For the CET1 Capital Ratio (cet), the response in Regime 1 is negative, with the CPI decreasing steadily throughout the entire 10-step horizon after a shock. This suggests that increasing the CET1 ratio (like strengthening bank capital requirements) during an expansion can have a deflationary effect by constraining banks' ability to lend, thus reducing inflationary pressures. During Regime 2, a shock to the CET1 ratio has a less pronounced impact, with a small initial negative effect on inflation that quickly diminishes. This implies that in a contraction phase, increasing capital requirements has a limited deflationary impact, likely because overall credit demand is already subdued and banks are less inclined to lend regardless of their capital buffers.

The impulse response analysis for CPI reveals that monetary policy shocks generally have a stronger impact on inflation during contractions compared to expansions. Specifically, increases in the money supply lead to higher inflation in Regime 2, highlighting the effectiveness of this tool in stimulating prices during downturns. Conversely, interest rate hikes reduce inflation in Regime 2, reflecting their stronger disinflationary effects during periods of economic weakness, where demand is already constrained. In Regime 1, the inflationary impact of money supply increases is still present but relatively more contained, suggesting that in times of growth, the economy may already be operating near capacity, limiting the effect of additional monetary stimulus on inflation. Similarly, the disinflationary effect of interest rate hikes in Regime 1 is more moderate, as higher demand and robust economic activity mitigate their impact. For macro-prudential policies, the Credit to GDP Gap has a positive influence on inflation in both regimes, though the effect is more pronounced during contractions. In contrast, increases in the CET1 Capital Ratio have a deflationary effect in Regime 1, implying that stricter capital requirements during growth phases help moderate inflation. However, in Regime 2, the deflationary impact of CET1 shocks is weaker, indicating that stricter capital requirements are less effective in influencing inflation during downturns, likely due to already weak credit conditions. These findings underscore the importance of adapting monetary and macro-prudential policies to the economic cycle, as their impact on inflation differs significantly between growth and contraction phases.

Dual-pillar policy's Impact on Unemployment rate of UK

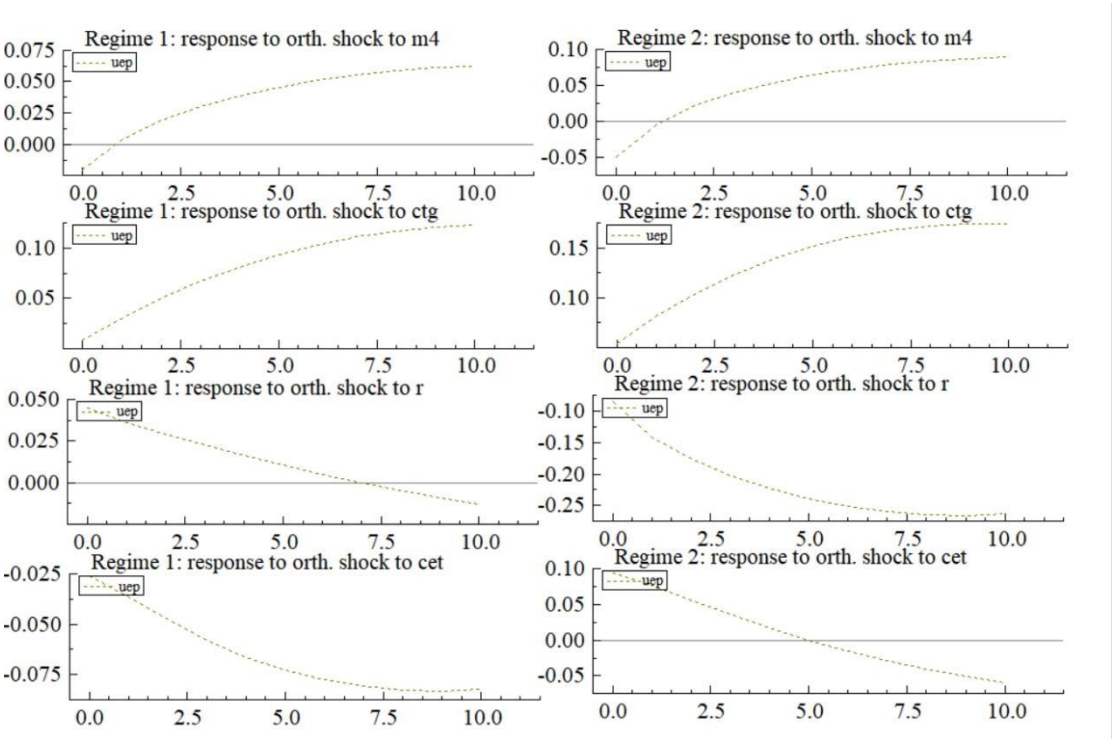


Figure 10. UK Impulse Responses of uep to shocks of other variables

In Regime 1 (Growth Phase), a shock to M4 results in a modest increase in the unemployment rate, which gradually rises over time, stabilizing around step 7 to 10. This indicates that an increase in money supply during a growth phase could inadvertently lead to inefficiencies in resource allocation or increased inflationary pressures that do not directly reduce unemployment, leading to a slightly elevated unemployment rate. In Regime 2 (Contraction Phase), the response to an M4 shock is initially more negative, with unemployment declining, indicating that increased liquidity helps reduce unemployment in the early stages. However, the response turns positive, reaching its peak at around step 5. This suggests that while an increase in money supply may provide initial relief to unemployment during contractions by stimulating demand, the effect may eventually lead to imbalances that could push unemployment back up.

For interest rate (r) shocks, the response in Regime 1 shows a slight initial increase in unemployment, peaking positively around step 2 before gradually returning toward zero. This suggests that higher interest rates during growth phases may temporarily dampen economic activity, leading to a modest rise in unemployment, likely due to reduced borrowing and investment activities. In Regime 2, the unemployment response to an interest rate shock is more pronounced, showing a sharp initial increase, reflecting that rate hikes during downturns exacerbate economic weakness and lead to higher unemployment. However, this effect peaks early and diminishes after step 5, suggesting that while rate hikes can significantly impact unemployment in the short term during contractions, the effects tend to dissipate as the economy adjusts over time.

The Credit to GDP Gap (ctg) shock reveals a distinct impact on unemployment. In Regime 1, the response is slightly positive, suggesting that an increase in the credit gap, often indicating unsustainable credit expansion, may lead to higher unemployment by the end of the 10-step period. This could reflect concerns over financial stability and the potential misallocation of credit that ultimately fails to create sustainable job growth. In Regime 2, the unemployment response to a credit gap shock is initially negative, reflecting that increased credit availability might support labor demand in the short run. However, as time progresses, the response turns positive, indicating that excessive credit could eventually contribute to financial instability and lead to increased unemployment.

For the CET1 Capital Ratio (cet), the response in Regime 1 shows a negative impact on unemployment, with the effect peaking around step 3 before slowly declining. This suggests that higher bank capital ratios during expansions, by improving bank resilience, can have a positive impact on job creation through more stable credit provision. In Regime 2, the response is initially negative but diminishes quickly and becomes positive by step 5. This suggests that increasing capital requirements during contractions may reduce unemployment in the short term by stabilizing the financial system, but over time it may restrict credit availability and slow job creation, ultimately leading to a rise in unemployment.

This analysis shows that monetary and macro-prudential policies have varying impacts on unemployment depending on the economic regime. During the growth phase (Regime 1), monetary policy shocks, such as changes in money supply and interest rates, have limited effects on increasing unemployment, indicating that the labor market may already be close to capacity. In particular, interest rate hikes (positive shocks) lead to a slight and temporary rise in unemployment, as higher borrowing costs marginally suppress investment and hiring in an otherwise robust economy. However, in the contraction phase (Regime 2), these policies have a more pronounced initial impact. Interest rate hikes exacerbate unemployment during downturns by reducing demand further when the labor market is already weak, although this effect diminishes over time as the economy adjusts. Regarding macro-prudential policies, the Credit to GDP Gap exhibits a dual effect—initially helping to reduce unemployment during contractions by facilitating credit access, but ultimately leading to higher unemployment due to potential financial instability from excessive credit growth. The CET1 Capital Ratio, on the other hand, is generally helpful in supporting employment during growth periods by enhancing bank stability. However, during contractions, its positive impact is short-lived, suggesting that while stronger capital requirements can stabilize the financial system, they may also restrict credit availability, limiting the capacity for job creation. These results emphasize the need for flexible and phase-specific policy measures that target unemployment effectively, balancing stability with economic growth.

Dual-pillar policy's Impact on non-performing loan rate of UK

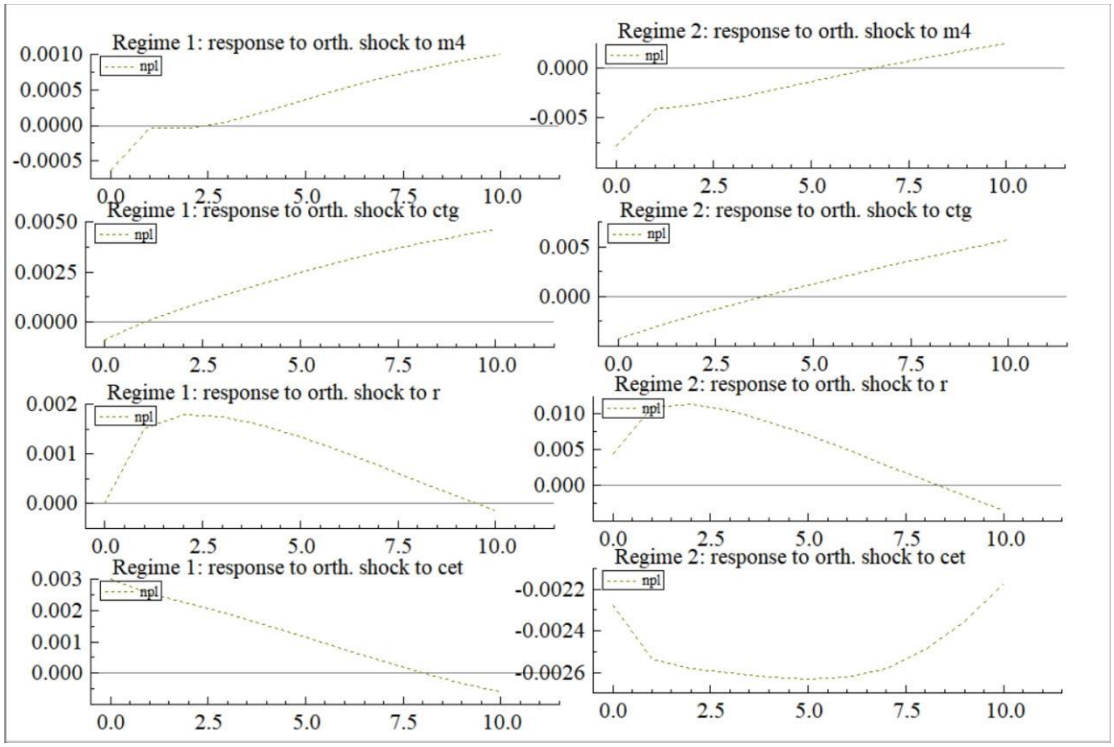


Figure 11. UK Impulse Responses of npl to shocks of other variables

Under figure 11, notably, the response of shock of cet is quite different between regime 1(expansion) and regime 2 (Contraction). In expansion stage, npl first goes positive and finally decreases to negative after 8 steps. In Contraction stage, cet is still negative after 10 steps. This implies under tightening stage, cet is more effective than expansion stage. Monetary measures will finally increase npl after several steps.

4.2.3 US

Table 11: Variable Descriptions for US

Variable Name	Description	Symbol	Original Indicator
Economic Growth Rate	Quarterly GDP Growth Rate	y	GDP
Financial Cycle Condition	Financial Cycle Index	fci	Financial Cycle Index
Money Supply	Monetary Policy	M2	Broad Money Supply (M2)
Interest Rate	Monetary Policy	r	7-Day Effective Federal Funds Rate
Liquidity Ratio	Macroprudential Policy	lcr	Liquid assets as a share of total assets
Common equity tier 1 ratio	Macroprudential Policy	cet	Common equity tier 1 ratio
Consumer price index	Quarterly CPI data	cpi	Consumer price index
Unemployment rate	Quarterly unemployment rate	uep	Unemployment rate
Non-Performing Loan rate	Non-performing Loans rate	npl	Commercial Bank Non-Performing Loan Ratio
Shadow rate	Monetary Policy	r_s	Shadow rate

Table 12: MS-VAR Model Estimation Results for US

Coefficients	fci	m2	r	cet	lcr	y
Const(Reg.1)	0.172770**	-0.018895	0.222034**	0.002184	-0.010824	0.053616
Const(Reg.2)	0.294036***	-0.038522	0.910908***	0.006635	-0.018375	0.104656**
fci_{t-1}	0.127088	0.009014	-1.547529	0.008743	0.038382	-0.015490
$M2_{t-1}$	1.743545***	0.284044***	1.769070***	0.027102	0.104179	0.950924***
r_{t-1}	0.019863	-0.001262	0.146549	-0.000861	-0.002339	0.026874

cet_{t-1}	-1.794110***	0.236458***	-6.764434***	0.925715	0.216044***	-0.443859***
lcr_{t-1}	-0.169024	0.018452	0.977561***	0.010780	0.957623***	-0.171981
y_{t-1}	0.263766	0.016519	-0.744855***	-0.000865	0.069806	-0.527236***
SE (Reg.1)	0.068926	0.024023	0.850589	0.003005	0.013907	0.017375
SE (Reg.2)	0.043397	0.006014	0.279577	0.001557	0.004315	0.022310
Log Likelihood	1594.5426					
AIC	-42.9298					

Table 13: MS-VAR Model Regime1 Correlation Matrix for US

	fci	m2	r	cet	lcr	y
fci	1.0000	-0.3202	0.2207	-0.4203	-0.1218	0.1765
m2	-0.3202	1.0000	-0.9592	0.7203	0.6290	-0.7297
r	0.2207	-0.9592	1.0000	-0.5507	-0.7166	0.7170
cet	-0.4203	0.7203	-0.5507	1.0000	0.1586	-0.6058
lcr	-0.1218	0.6290	-0.7166	0.1586	1.0000	-0.3076
y	0.1765	-0.7297	0.7170	-0.6058	-0.3076	1.0000

Table 14: MS-VAR Model Regime2 Correlation Matrix for US

	fci	m2	r	cet	lcr	y
fci	1.0000	-0.3216	-0.2038	0.0655	0.0395	0.0059
m2	-0.3216	1.0000	-0.2100	-0.2061	0.1406	0.0970
r	-0.2038	-0.2100	1.0000	0.0087	-0.2826	-0.3156
cet	0.0655	-0.2061	0.0087	1.0000	0.0330	-0.3954
lcr	0.0395	0.1406	-0.2826	0.0330	1.0000	0.0515
y	0.0059	0.0970	-0.3156	-0.3954	0.0515	1.0000

Based on table 13 and 14, the correlation matrices reveal notable differences between Regime 1 and Regime 2, implying dual-pillar policy’s different effect on two regimes. The correlation between M2 and r is strongly negative in Regime 1 (-0.9592) but weakens significantly in Regime 2 (-0.2100). Similarly, the correlation between M2 and y shifts from a strong negative value in Regime 1 (-0.7297) to a weak positive value in Regime 2 (0.0970). The relationship between r and y also shows a reversal, moving from a strong positive correlation in Regime 1 (0.7170) to a moderate negative correlation in Regime 2 (-0.3156). Additionally, the correlation between cet and y is less negative in Regime 2 (-0.3954) compared to Regime 1 (-0.6058), while the correlation between r and lcr weakens from -0.7166 in Regime 1 to -0.2826 in Regime 2. These differences highlight significant shifts in variable relationships across the two regimes. Specific analysis of these shifts will present in impulse-response part.

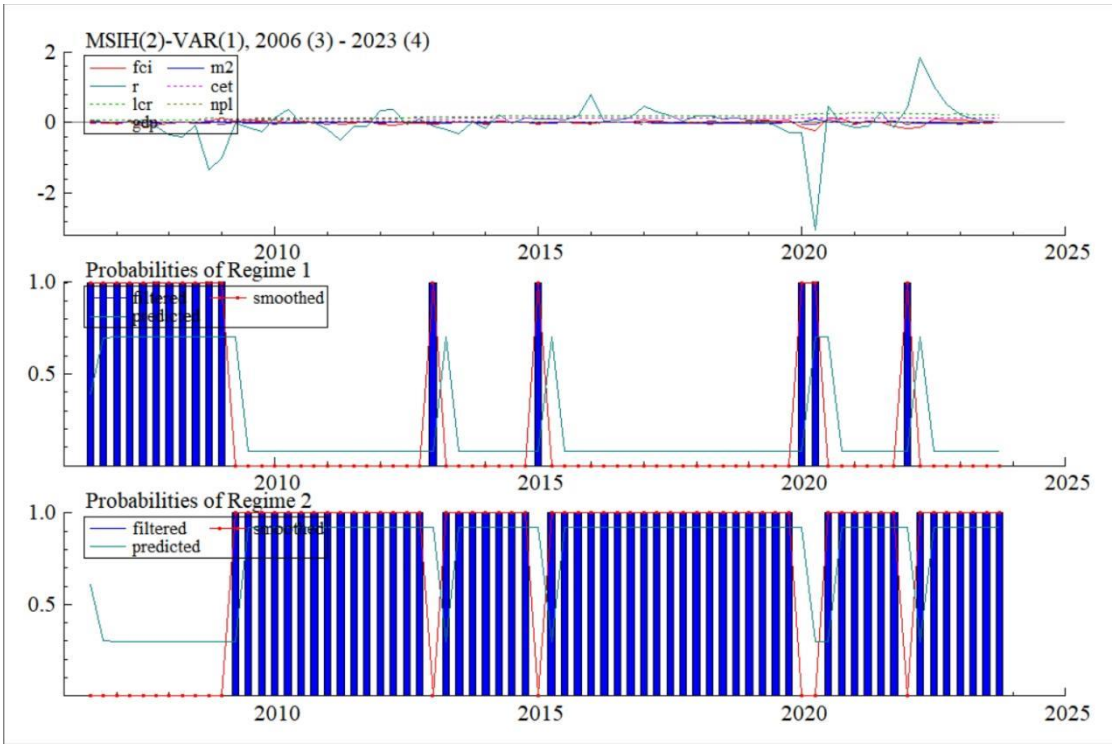


Figure 12. Regime Probabilities of US

Figure 12 reveals that the economy predominantly stays in periods of expansion, with Regime 2 (expansion) having a high self-sustaining probability and an average duration of 5.58 quarters. In contrast, Regime 1 (recession) is less frequent, with an average duration of only 2.47 quarters, indicating that recessions are relatively short-lived. This highlights the longer-lasting and stable nature of expansions, compared to the shorter and less frequent recessions.

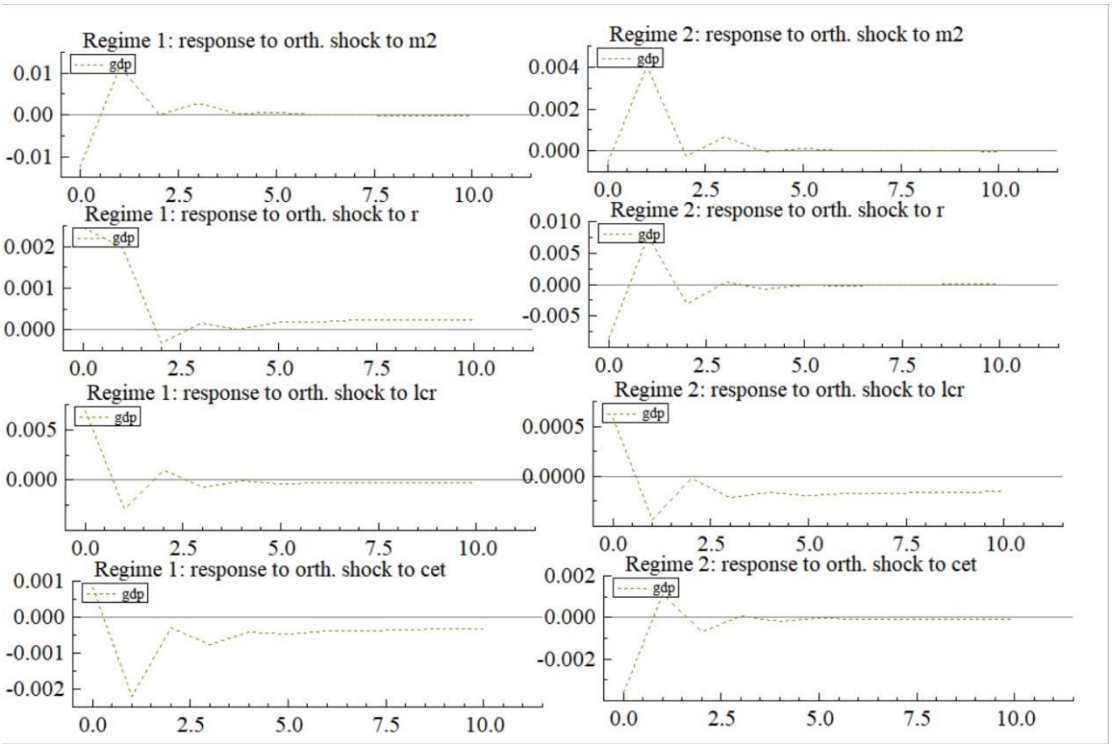


Figure 13. responses of output to shocks of other variables

Based on figure 13, in Regime 1 (recession) , a shock to M2 initially results in a slight positive impact on output, which quickly diminishes and stabilizes around zero. This suggests that during a recession, increasing money supply provides only a short-lived boost to economic growth, with limited long-term effectiveness. Similarly, a shock to the interest rate (r) shows a brief negative effect on GDP, which rapidly diminishes. This indicates that interest rate increases during recessions suppress growth but have a fleeting impact as the economy adjusts. In the growth phase, M2 shocks exhibit a smaller positive impact on GDP compared to Regime 1, which again fades quickly. This suggests that increasing money supply during a growth phase contributes little to further economic expansion, with even weaker effects than during a recession. For interest rate shocks, there is an initial negative response in GDP, which then stabilizes near zero after step 2, highlighting that rate hikes during growth suppress activity at first but tend to have limited long-term effects as the economy adjusts.

For macro-prudential policy variables, in regime 1, a shock to the Liquidity Ratio (LCR) has a small initial positive effect on GDP, but this effect dissipates almost immediately, implying that increasing liquidity requirements during a recession has minimal sustained influence on economic growth. A shock to the CET1 Capital Ratio initially shows a negative impact on GDP, though it quickly stabilizes close to zero. This suggests that increasing capital requirements during a recession might slightly hinder economic recovery, but the effect is relatively short-lived. In regime 2, LCR shocks in the growth phase also show a small positive impact on GDP, which quickly fades. Similarly, CET1 Capital Ratio shocks exhibit an initial negative impact on GDP, which diminishes rapidly. This pattern implies that increasing liquidity or capital requirements during growth periods could slightly dampen economic activity but with minimal long-term consequences.

Overall, both monetary and macro-prudential policy shocks tend to have limited and short-lived impacts on GDP in both phases. During the recession phase (Regime 1), increasing money supply provides a small, transient boost to GDP, while interest rate hikes have a slightly negative but short-lived impact on growth. Macro-prudential measures, such as increasing LCR and CET1 ratios, generally have a slightly negative or neutral impact on GDP during this phase. In the growth phase (Regime 2), the effects of these shocks are generally weaker and diminish quickly. Interest rate hikes initially suppress GDP but have limited long-term effects as the economy adjusts, while money supply increases offer little additional support to growth. This suggests that policy interventions in both phases should be carefully calibrated, as their influence on GDP growth is both temporary and context-dependent.

Dual-pillar policy's Impact on Inflation of US

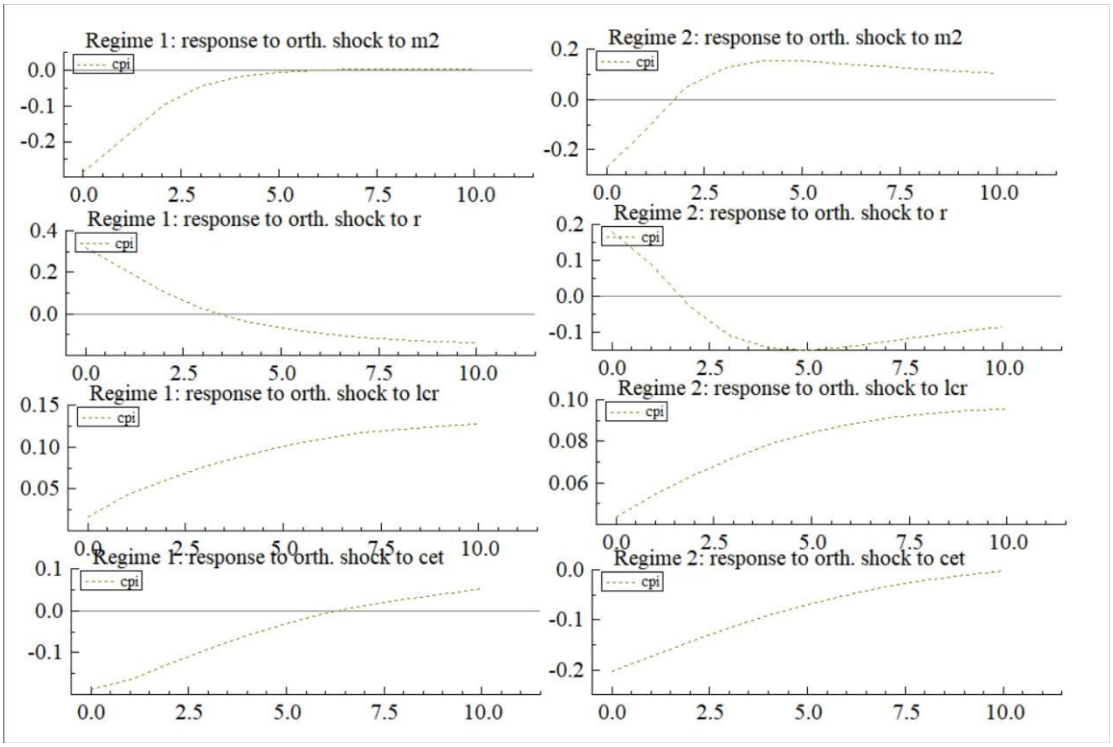


Figure 14. responses of inflation to shocks of other variables

In Regime 1 (Recession Phase), shocks to monetary and macro-prudential policies show varied impacts on CPI. An increase in M2 results in a significant initial decrease in CPI, suggesting that raising the money supply during a recession does not effectively stimulate inflation due to weak demand. Increase interest rate have a notable initial positive effect on CPI, but this effect will goes negative after 3 steps. A shock to the Liquidity Ratio (lcr) results in a positive and sustained impact on CPI, implying that higher liquidity requirements during recessions might bolster inflation by improving financial stability and confidence. However, a shock to the CET1 Capital Ratio shows a slight negative impact on CPI, indicating that stricter capital requirements might suppress inflation in the short term by limiting bank lending.

In Regime 2 (Growth Phase), an increase in M2 initially has a negative effect on CPI but eventually turns positive, suggesting that expanding the money supply gradually contributes to inflation as economic activity picks up. A shock to the interest rate tends to have similar effect on inflation. For macro-prudential policies, both LCR and CET1 shocks result in relatively small impacts on CPI, with LCR having a positive effect and CET1 having an initial negative influence that quickly fades. This suggests that in the growth phase, adjustments to liquidity and capital requirements have moderate effects on inflation.

Overall, the analysis reveals that during a recession, monetary policy measures like increasing money supply or cutting interest rates will gradually have positive effects on inflation, while macro-prudential policies such as raising liquidity ratios tend to support inflation. Raise in cet could reduce inflation. In the growth phase, monetary and macro-prudential measures have more limited and transient impacts on inflation, indicating that their effectiveness is context-dependent and more subdued during economic expansion.

Dual-pillar policy's Impact on non-performing loan rate of US

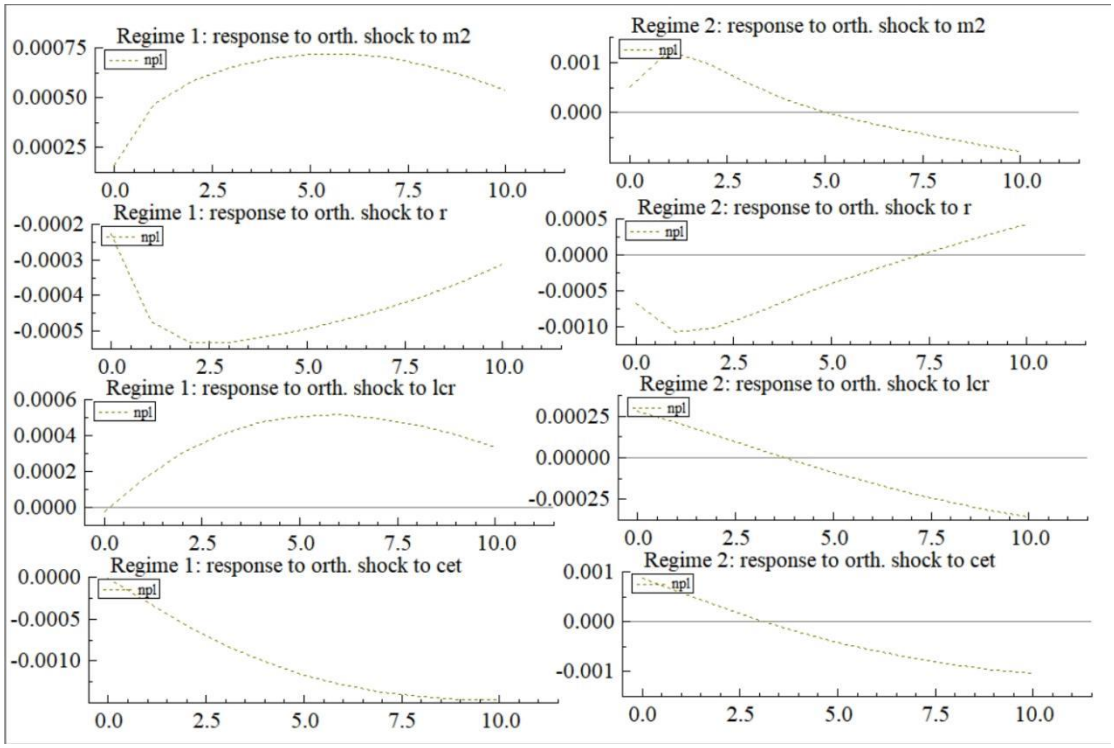


Figure 15. responses of output to shocks of other variables

In Regime 1 (Recession Phase), a shock to M2 results in a slight positive effect on NPL, which peaks and then gradually diminishes. This indicates that during periods of recession, increasing money supply may lead to an accumulation of non-performing loans, possibly due to inefficient credit allocation in a weak economic environment. A shock to the interest rate (r) shows an initial positive impact on NPL, which gradually declines but remains above zero, suggesting that increasing interest rates during a recession exacerbates non-performing loans by placing additional pressure on borrowers who are already struggling. For Liquidity Ratio (LCR) shocks, the response is slightly negative, indicating that higher liquidity requirements can help stabilize or reduce NPL during downturns by promoting financial resilience. A shock to the CET1 Capital Ratio (CET1) shows an initial strong negative effect on NPL, which gradually diminishes, suggesting that stricter capital requirements during recessions can enhance financial stability by reducing the accumulation of non-performing loans.

In Regime 2 (Expansion Phase), the M2 shock results in a smaller positive effect on NPL compared to Regime 1, and the impact fades more quickly. This implies that increasing money supply during periods of growth has a less significant effect on NPLs, as the stronger economic environment supports more efficient credit allocation. A shock to the interest rate (r) shows an initial positive impact on NPL, which then diminishes and stabilizes near zero, reflecting that higher interest rates during growth phases increase NPL initially but have a limited long-term effect as the economy adjusts. LCR shocks show a slight positive effect on NPL, indicating that higher liquidity requirements during expansions may lead to a marginal increase in NPLs, likely due to banks' more risk-averse behavior restricting credit to certain sectors. Finally, the CET1 shock has a weaker negative impact on NPL compared to Regime 1, suggesting that higher capital requirements during periods of growth still help reduce financial instability, but their effect is less pronounced in an expanding economy.

In summary, during the recession phase (Regime 1), increasing money supply and raising interest rates both contribute to higher NPL, while stricter liquidity (LCR) and capital requirements (CET1) generally help reduce NPL and stabilize the financial system. During the expansion phase (Regime 2), money supply shocks have a smaller and more transient impact on NPLs, while interest rate hikes continue to contribute to NPL but with diminishing long-term effects. Higher LCR and CET1 ratios have mixed effects, with LCR slightly increasing NPLs due to constrained credit availability, and CET1 continuing to promote financial stability with a weaker impact compared to recessions. These findings highlight the importance of tailoring monetary and macro-prudential measures to the economic cycle to effectively manage financial stability and mitigate non-performing loans.

To reduce non-performing loans rate, the Federal Reserve can adopt tailored policy combinations depending on the financial phase. During a recession, increasing liquidity requirements (LCR) and strengthening capital adequacy can stabilize the financial system and limit NPL growth, while avoiding aggressive interest rate hikes to prevent further strain on borrowers. In an expansion, maintaining robust CET1 ratios continues to enhance financial stability, while carefully calibrated interest rate increases and moderate adjustments to liquidity requirements can help manage credit risks without significantly increasing NPL rates. Additionally, avoiding excessive monetary expansion during both phases can minimize inefficient credit allocation and prevent long-term increases in NPL.

Dual-pillar policy's Impact on unemployment rate of US

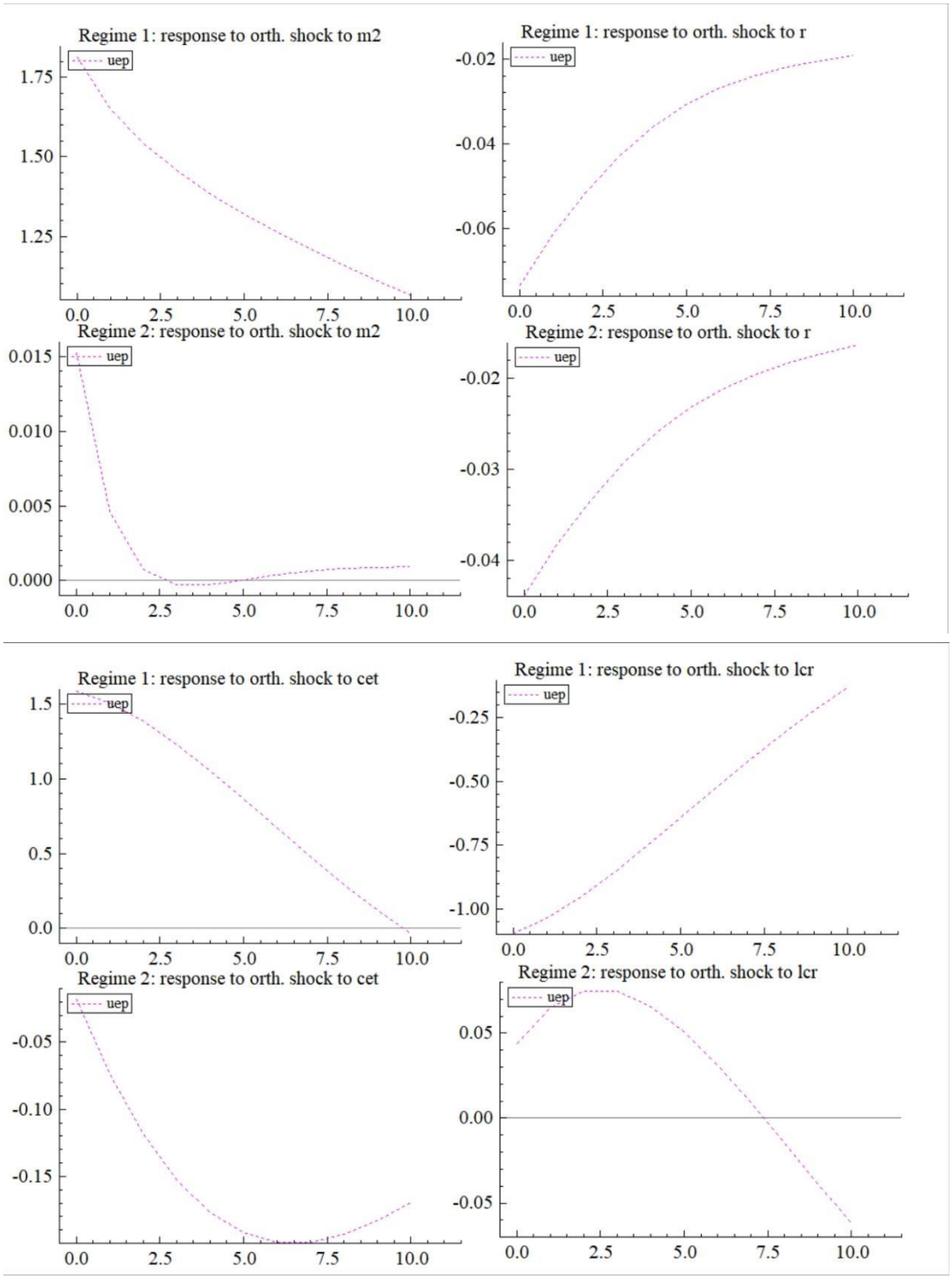


Figure 16. responses of output to shocks of other variables

Based on figure 16, during recession stage, shock to M2 has a huge effect on unemployment rate of the US, but has a more smaller effect during expansion stage. The initial response of unemployment to an M2 shock in recession phase, shows a significant increase in unemployment before gradually returning to zero around the 10th period. This counterintuitive result could be explained by the potential lag in monetary policy transmission mechanisms and the role of expectations. When M2 increases unexpectedly during a recession, it may initially signal financial instability or heightened economic risks to markets, leading to cautious behavior by firms and households. Businesses might delay hiring or reduce their workforce due to uncertainty, while consumers might hold back on spending despite increased liquidity, both contributing to a temporary rise in unemployment. Additionally, the immediate effect of a monetary expansion may exacerbate structural or credit-related issues in the short term. Over time, as confidence in the economy is restored and credit channels normalize, the positive effects of increased M2 start to materialize, gradually offsetting the initial rise in unemployment. As for macro-prudential measures, the responses of cet and lcr in two stages are much different. An increase in cet leads to a high rise of unemployment rate in recession stage, but in expansion stage, the effect is much smaller. Lcr has moderate impact on unemployment rate in two stages.

4.2.4 Eurozone

The variables picked for the Euro Zone are shown in Table 15. Because those Macro-prudential policy indicators started in 2015, this paper constructs two models to see impulse response results.

Table 15: Variable Descriptions for Euro Zone

Variable Name	Description	Symbol	Original Indicator
Economic Growth Rate	Quarterly GDP Growth Rate	y	GDP
Financial Cycle Condition	Financial Cycle Index	fci	Financial Cycle Index
Money Supply	Monetary Policy	M3	Broad Money Supply (M3)
Interest Rate	Monetary Policy	r	7-Day Euribor Rate
Common equity tier 1 ratio	Macroprudential Policy	cet	Common equity tier 1 ratio
Liquidity coverage ratio	Macroprudential Policy	lcr	Liquidity coverage ratio
Consumer price	Quarterly CPI data	cpi	Consumer price index

index			
Unemployment rate	Quarterly unemployment rate	uep	Unemployment rate
Non-Performing Loans ratio	Quarterly Non-performing Loans ratio	npl	Commercial Bank Non-Performing Loans Ratio
Shadow rate	Monetary Policy	r_s	Shadow rate

Table 16: Monetary Policy MS-VAR Model Estimation Results for Eurozone

	fci	m3	r	Y
Const(Reg.1)	0.007918	0.007087	0.041129	0.001713
Const(Reg.2)	-0.012964	0.006458	-0.118740	-0.003804
fci_{t-1}	0.261191***	-0.237392*	-0.145079	-0.073865
$M3_{t-1}$	0.010209	0.672458**	-0.069404	-0.003872
r_{t-1}	-0.085088	-0.110796	0.205636*	-0.003074
Y_{t-1}	1.720350***	0.530803**	-0.190929	-0.754119***
SE (Reg.1)	0.162772	0.401316	0.125260	0.018922
SE (Reg.2)	0.106069	0.969091	1.544681	0.049149
Loglikelihood	142.6495			
AIC	-2.7614			

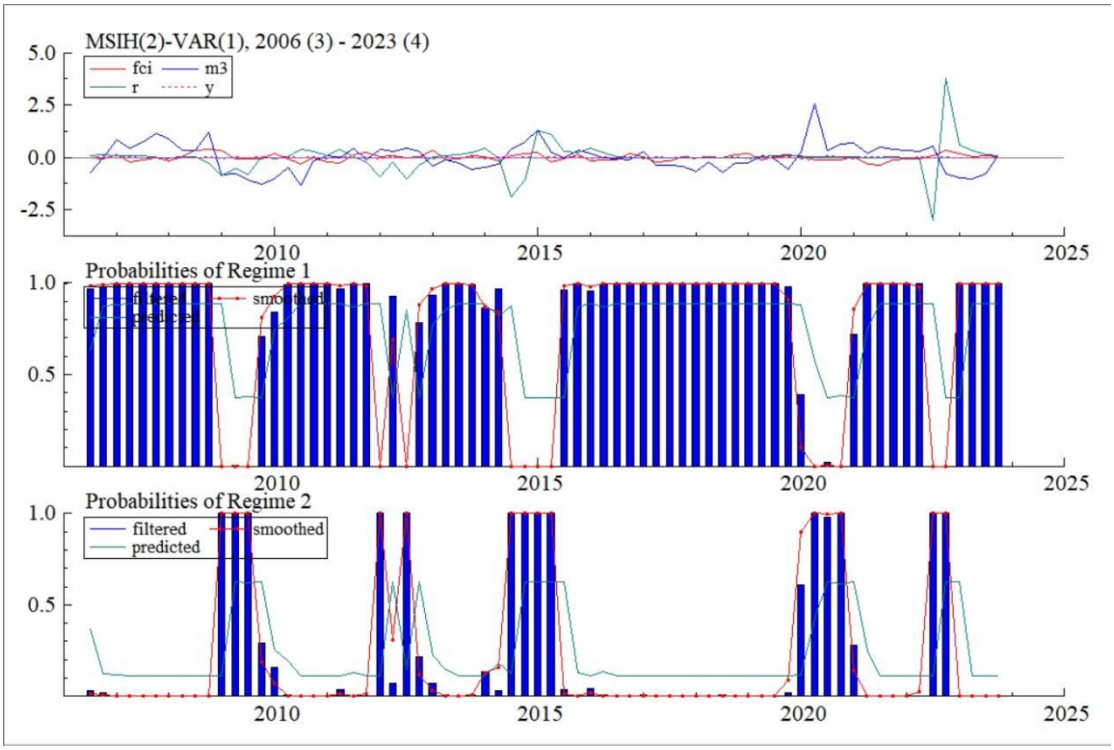


Figure 8. Regime Probabilities of Euro Zone

Figure 8 indicates that the EU economy spends the majority of its time in Regime 1, representing periods of recession or weaker economic conditions, with a high persistence of 89.02% and an average duration of 9.11 quarters. In contrast, Regime 2, representing periods of economic expansion, is less frequent and shorter-lived, with a lower persistence of 62.48% and an average duration of just 2.67 quarters. This suggests that the Eurozone experiences prolonged periods of financial downturns, while periods of growth are relatively short and less stable, with a higher probability of returning to recessionary conditions.

Table 17: Monetary Policy MS-VAR Model Regime1 Correlation Matrix for EURO ZONE

	fci	m3	r	Y
fci	1.0000	0.2230	-0.3833	0.1955
m3	0.2230	1.0000	-0.2574	0.1485
r	-0.3833	-0.2574	1.0000	-0.2140
Y	0.1955	0.1485	-0.2140	1.0000

Table 18: Monetary Policy MS-VAR Model Regime2 Correlation Matrix for EURO ZONE

	fci	m3	r	Y
fci	1.0000	-0.2374	-0.0552	-0.3020

m3	-0.2374	1.0000	-0.2841	-0.5002
r	-0.0552	-0.2841	1.0000	0.0855
Y	-0.3020	-0.5002	0.0855	1.0000

Based on table 17 and 18, they reveal notable differences between Regime 1 and Regime 2 for several key variables. The correlation between M3 and Y shifts from a weak positive value in Regime 1 (0.1485) to a moderate negative value in Regime 2 (-0.5002), indicating a significant change in their relationship. The correlation between r and Y also reverses, moving from a weak negative correlation in Regime 1 (-0.2140) to a weak positive correlation in Regime 2 (0.0855). Additionally, the relationship between M3 and r changes slightly, weakening from -0.2574 in Regime 1 to -0.2841 in Regime 2. These changes imply effects of dual-pillar policy are different under different regimes.

Table 19: Macro-prudential Policy MS-VAR Model Estimation Results for EURO ZONE

	fci	cet	lcr	Y
Const(Reg.1)	2.566280***	0.147311***	-0.202153***	0.493061***
Const(Reg.2)	2.711688***	0.149508***	-0.196876***	0.511302***
fci_{t-1}	0.196725***	-0.000467	1.019004***	-0.067135***
cet_{t-1}	-13.717345***	0.353375***	1.104300***	-2.554366***
lcr_{t-1}	-0.340110***	-0.042941***	1.016949***	-0.086949***
Y_{t-1}	1.595131***	-0.014973***	0.087838***	-0.633982
SE (Reg.1)	0.123642	0.003542	0.014830	0.055760
SE (Reg.2)	0.115314	0.001732	0.007579	0.013575
Log-Likelihood	609.8200			
AIC	-31.9306			

Table 20: Macro-prudential Policy MS-VAR Model Regime1 Correlation Matrix for EURO ZONE

	fci	cet	ltd	Y
fci	1.0000	-0.1736	0.0657	-0.3291
cet	-0.1736	1.0000	-0.7165	0.1707
ltd	0.0657	-0.7165	1.0000	0.3393
Y	-0.3291	0.1707	0.3393	1.0000

Table 21: Macro-prudential Policy MS-VAR Model Regime2 Correlation Matrix for EURO ZONE

	fci	cet	ltd	Y
fci	1.0000	0.2446	-0.2464	0.5906
cet	0.2446	1.0000	-0.2882	0.6624
ltd	-0.2464	-0.2882	1.0000	-0.2034
Y	0.5906	0.6624	-0.2034	1.0000

Based on table 20 and 21, it could be still found that some notable changes of coefficient, for example, correlation between lcr and y turns from positive to negative.

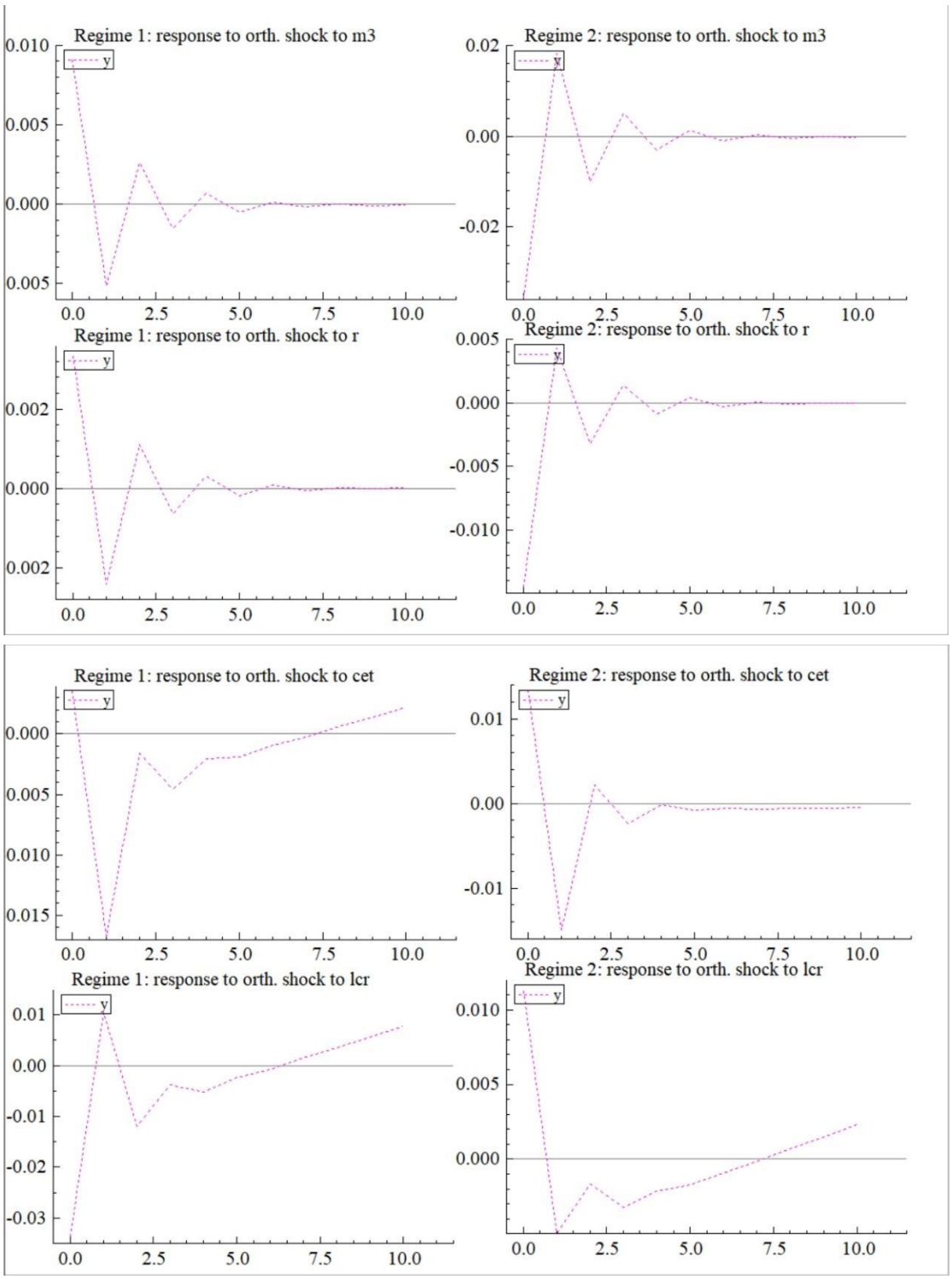


Figure 18. Impulse Responses of output to shocks of other variables

Based on figure 18, here, in Regime 1(recession), a positive shock to M3 leads to a brief spike in growth, but the effect quickly dissipates after 7 steps. However, in Regime 2 (expansion), a shock of M3 first lead to a negative response of output and then after only one step, output reaches the highest. This implies transmission mechanism of M3 to output differs across financial regimes, although it contributes to output growth in both stages at early steps. Similarly, an increase in r produces a slight initial boost in output, possibly signaling confidence or inflation control, but the effect soon fades. In regime 2, a shock to r during

expansion leads to a strong positive response in output initially, as rising interest rates may signal confidence in the economy’s strength. However, the effect stabilizes as the higher cost of credit begins to offset initial optimism.

In contrast, shocks to macro-prudential policies in Regime 1 have more severe and lasting effects on output. A positive shock to cet leads to a sharp drop in economic growth, reflecting the negative consequences of tighter capital requirements on lending and investment. In Regime 2, Macro-prudential shocks during expansions tend to have smaller and more temporary effects on output. For instance, a shock to cet produces a small negative impact on growth, which stabilizes quickly, which may indicates that the economy can absorb higher capital requirements more easily during periods of growth.

To enhance output in the Eurozone, policy makers could implement strategies as follow. During recessions (Regime 1), monetary policy should focus on increasing M3 to provide a short-term boost to output, even though its effects are temporary and careful managing interest rates; maintaining low rates can prevent the dampening effects of high credit costs while avoiding overly sharp increases that might undermine confidence. Macro-prudential policies, such as adjusting CET requirements, should be eased to encourage lending and investment, as tighter capital requirements have a significant negative impact on output during recessions. In expansions (Regime 2), monetary policy should aim to maintain a balance. Moderate increases in M3 can support output, but large shocks should be avoided to prevent inefficiencies. Similarly, modest interest rate hikes can reinforce confidence without significantly increasing the cost of credit. Macro-prudential policies like raising CET ratios should be gradually implemented, as their negative impact on growth is smaller and more temporary during periods of economic expansion. These adjustments would ensure stability while fostering sustained growth.

Dual-pillar policy's Impact on inflation of EU

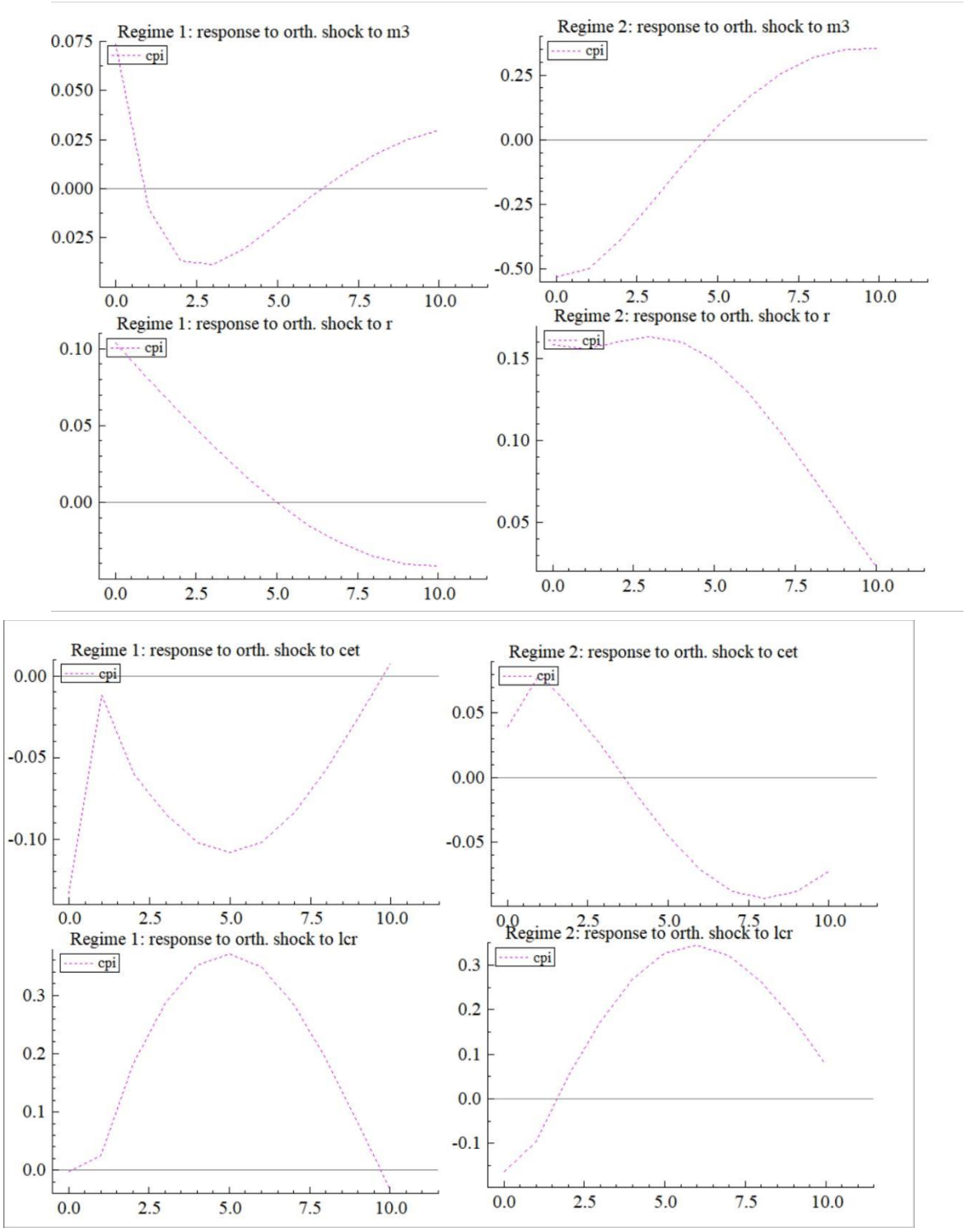


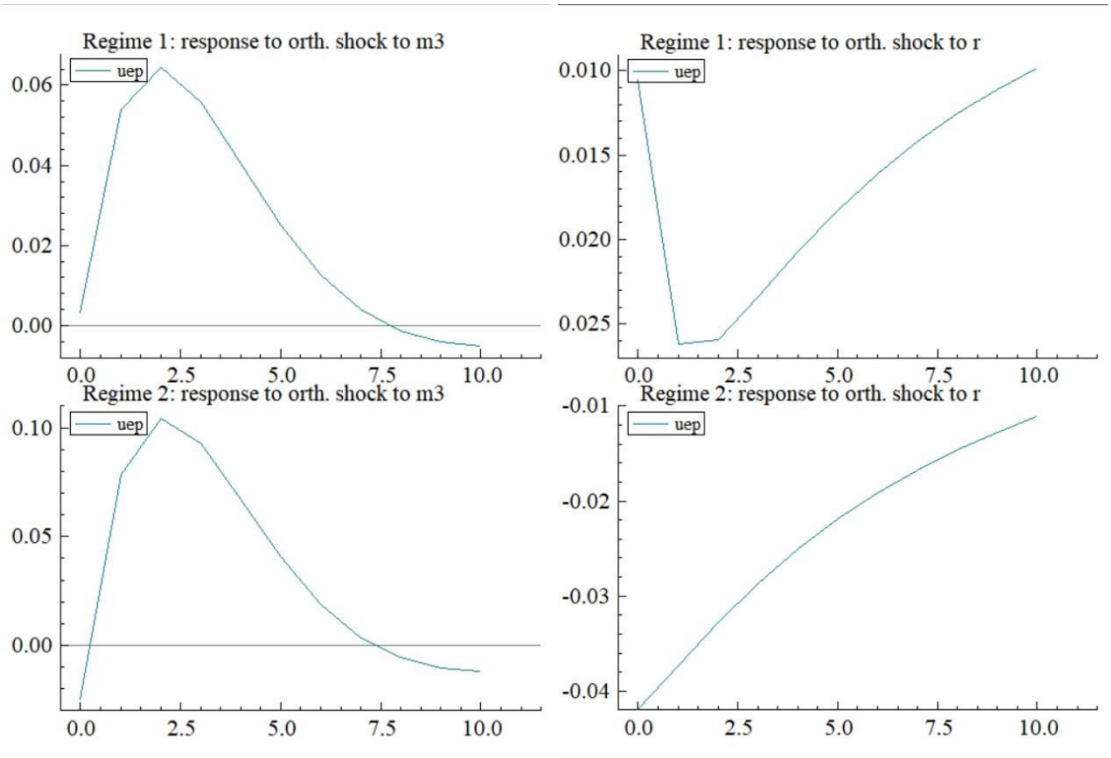
Figure 19. Impulse Responses of cpi to shocks of other variables

Starting with monetary policy shocks, the response of the CPI to a shock in m3 differs notably. In Regime 1, an m3 shock initially increases the CPI but quickly declines, even turning slightly negative, suggesting that during financial recessions, the inflationary impact of increased money supply is short-lived. Conversely, in Regime 2, the positive impact of an

m3 shock on CPI is more persistent and significant, indicating that in financial booms, the transmission of money supply to inflation is more effective. For shocks to r , Regime 1 shows a clear and sustained negative impact on CPI, emphasizing the strong disinflationary effects of higher interest rates during financial downturns. In contrast, during Regime 2, the response to r initially rises slightly before falling, demonstrating a weaker disinflationary effect compared to the recessionary regime, likely due to delayed policy transmission in booming conditions.

For macro-prudential shocks, the Common Equity Tier 1 (cet) ratio and the Liquidity Coverage Ratio (lcr) show nuanced effects. In Regime 1, a cet shock has a short-term negative impact on CPI, followed by gradual recovery, indicating that higher capital requirements can restrict credit supply and dampen inflation during recessions. In Regime 2, the cet shock initially raises CPI but quickly turns negative, suggesting that in financial booms, stricter capital regulation leads to credit tightening, moderating inflation. lcr shocks, on the other hand, exhibit a pronounced positive impact on CPI in both regimes, with a peak effect around the mid-horizon, reflecting how improvements in bank liquidity support credit supply and stimulate inflationary pressures, though the magnitude is slightly smaller in booms. Overall, the results underscore the asymmetry in the transmission mechanisms of monetary and macro-prudential policies across financial regimes, with monetary policy exhibiting stronger effects in recessions and macro-prudential policies showing time-varying impacts depending on financial conditions.

Dual-pillar policy's Impact on Unemployment rate of EU



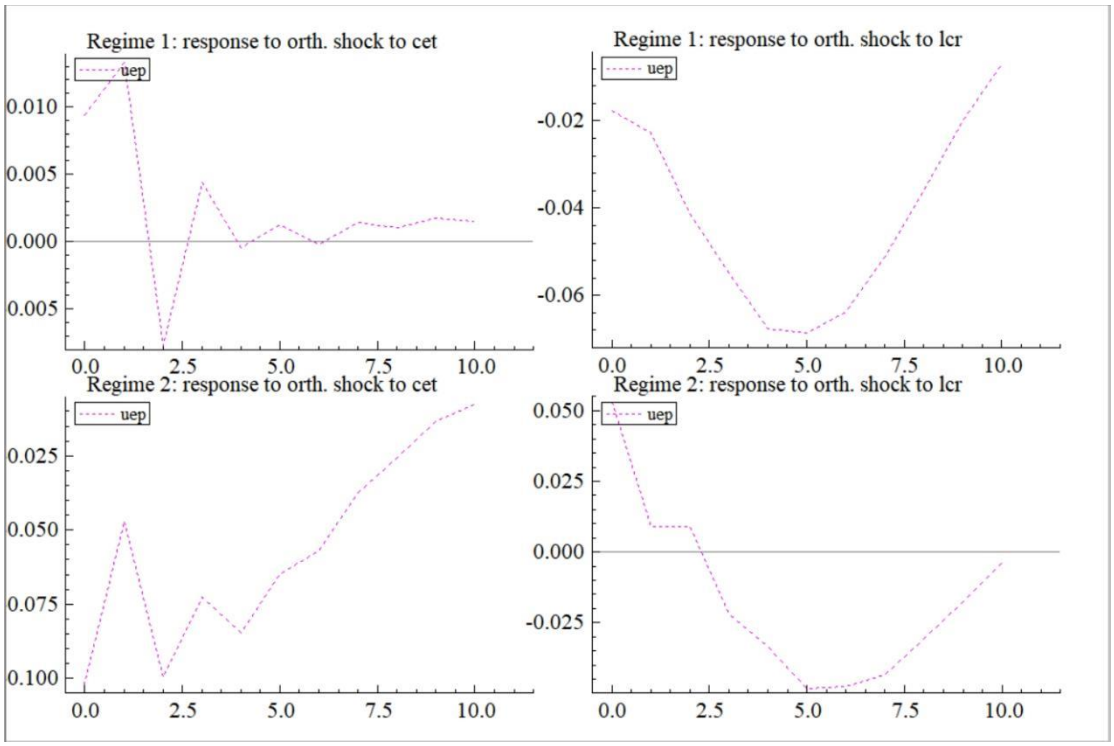


Figure 20. Impulse Responses of uep to shocks of other variables

Based on figure 20, the steps and response intensity of uep on M3 are similar in two stages. This implies M3 is not important in decreasing unemployment rate. A rise in r can finally lead to a increase in uep in both stages, although steps are slightly different. As for macro-prudential measures, cet could lead to a high long-term increase of uep in expansion stage. Thus, ECB should not tighten much cet policies in financial expansion phase.

Dual-pillar policy's Impact on Non-performing Loans rate of EU

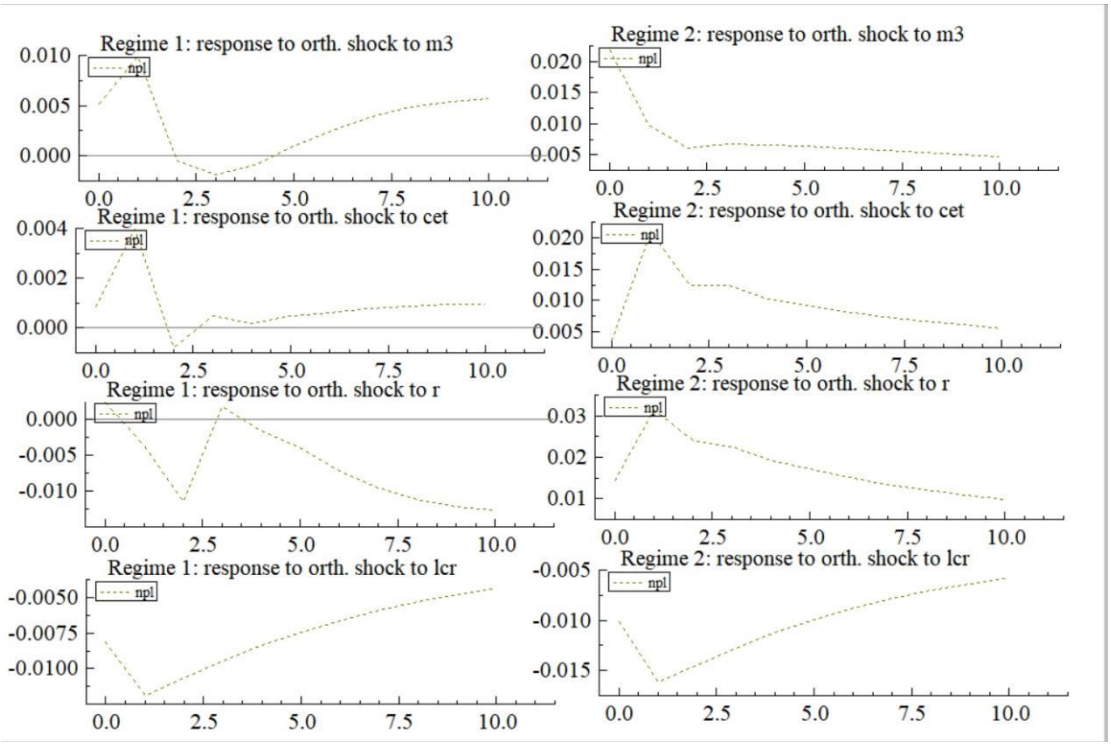


Figure 21. Impulse Responses of npl to shocks of other variables

Based on figure 21, during recessions (Regime 1), an M3 shock initially has little effect on NPL but gradually increases it over time, suggesting that expanded liquidity might encourage riskier lending practices. Similarly, in booms (Regime 2), the same shock initially gives more intensity of npl response and gradually decreases after 10 periods. As for macro-prudential measures, lcr is more effective to reduce npl in expansion stage than recession stage. Cet in two stages generally increase npl. Interest rate has different effect in different stages, in expansion phase, it will first increase npl, but will decrease npl in recession phase. Therefore, if ECB wants to reduce non-performing loans, it could tighten lcr and also focus on financial stages because r has different effect in different phases.

Shadow rate analysis of four countries

According to Wu and Xia (2016), shadow rate plays a crucial role in capturing the stance of monetary policy when conventional policy rates, such as the federal funds rate, are constrained by the zero lower bound. Unlike nominal interest rates, which become uninformative during periods of near-zero policy rates, the shadow rate provides a continuous measure of monetary policy accommodation by incorporating information from the yield curve.

Given its ability to capture broader policy effects beyond the zero lower bound, the shadow rate is increasingly used in empirical research to analyze monetary policy transmission, financial conditions, and business cycle dynamics. This study employs the shadow rate to assess the regime-dependent impact of monetary policy shocks in an MS-VAR framework, allowing for a more comprehensive evaluation of monetary policy effects under different economic conditions. Furthermore, this study also analyses the differences of results

between inter-bank rate and shadow rate.

UK shadow rate analysis

This study replace inter-bank rate with shadow rate to do further analysis.

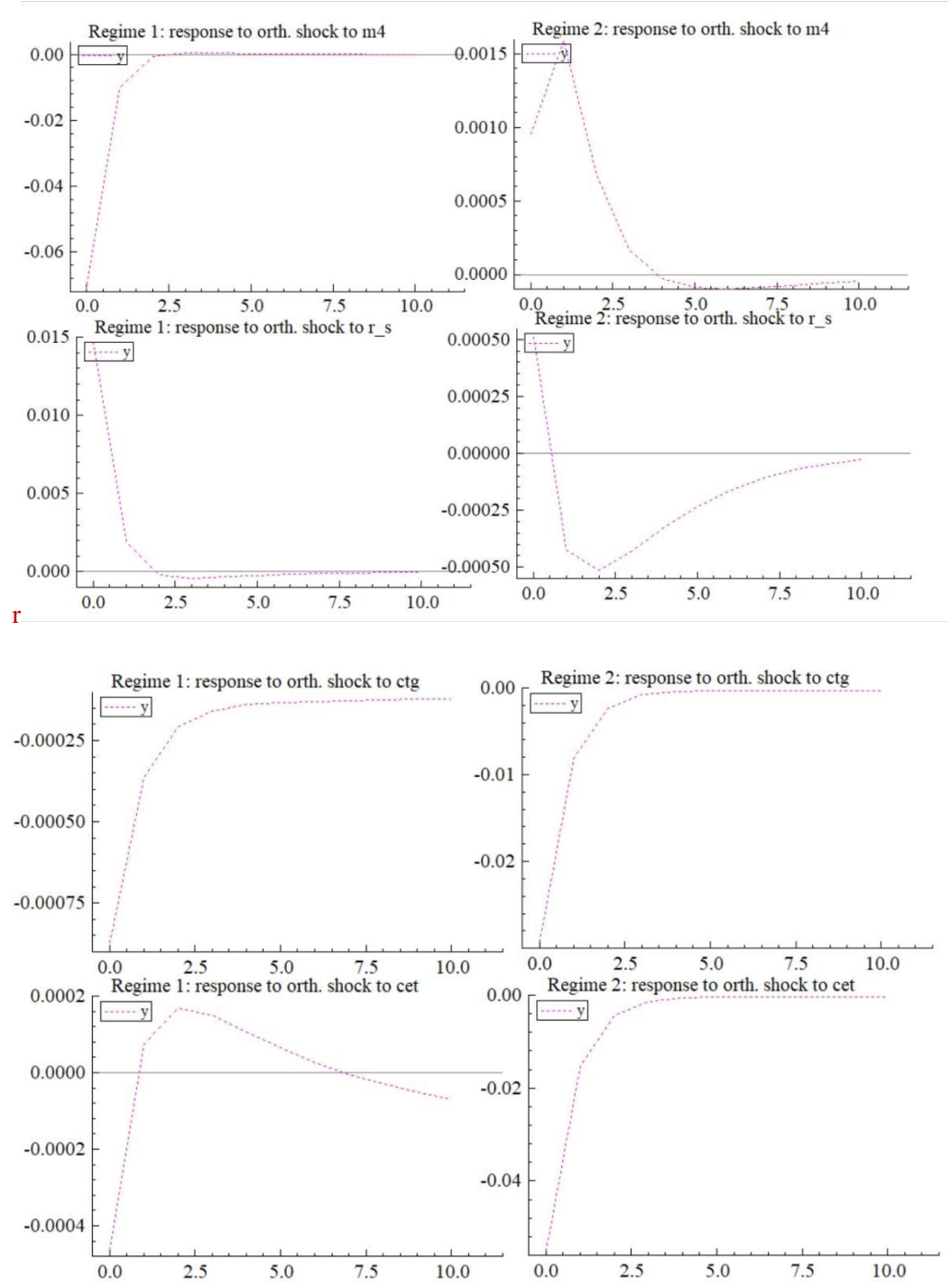


Figure 22. Impulse Responses of y to shocks of other variables

Based on figure 22, the macro-prudential tools' impact on output in two regimes are smaller and similar to previous analysis of inter-bank rate. However, the differences can be seen on monetary tools. The response steps of shadow rate are similar, but the intensity is slightly different. In growth phase (regime2), the effect is smaller and will have some steps'

negative effect. The money supply also has small positive effect, but has negative effect in recession phase (regime1).

Compared to inter-bank rate analysis, the shadow rate results are more in line with the anticipated outcomes. In previous inter-bank rate analysis, the steps of interest rate and money supply are significantly different and the impact of money supply is negative in two regimes. While in shadow rate analysis, steps of interest rate are similar and money supply has positive effect on output in growth phase though small. This may be caused by shadow rate can go far negative and thus has more impact on output in the model. It indicates that shadow rate can be more effective in analyzing monetary policies' effectiveness.

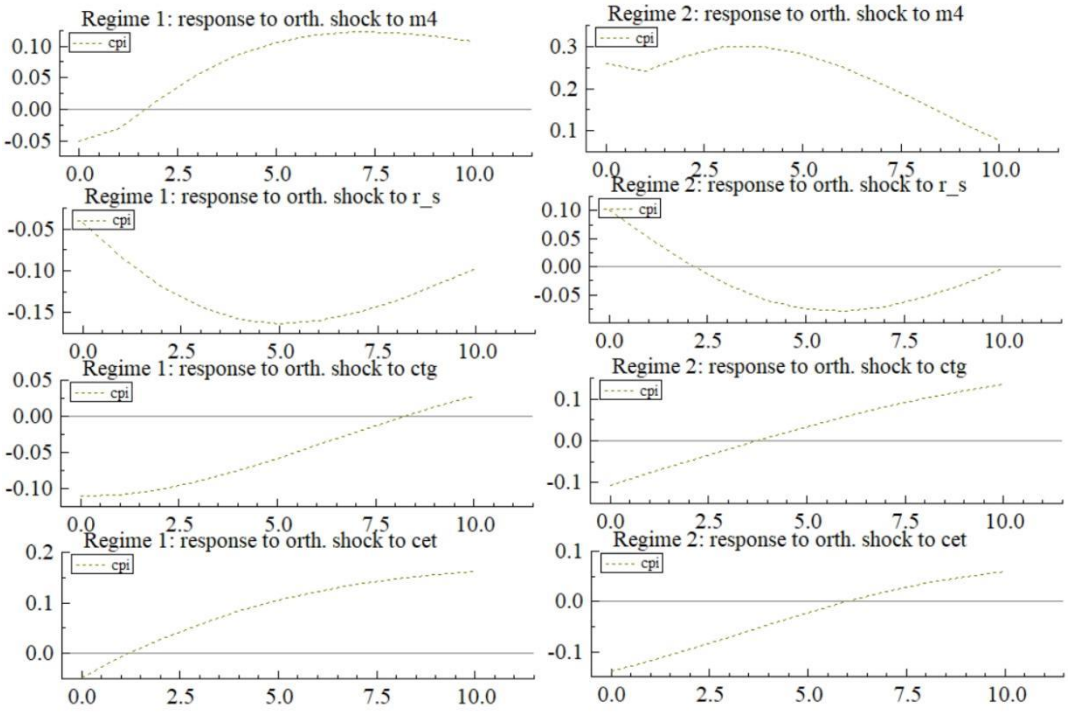


Figure 23. Impulse Responses of cpi to shocks of other variables

The results in figure 23 are quite different compared to previous inter-bank rate analysis. The money supply results are similar though it has a substantially small negative effect on inflation at first. Generally, all positive shock of money supply contributes to increasing inflation in two analysis. However, an increase in shadow rate of UK can cause a decrease in inflation as expected. Only in growth phase (regime 2), it has a small positive effect at first but will goes to negative after 2 steps. Inter-bank rate can has slightly positive effect in all regimes.

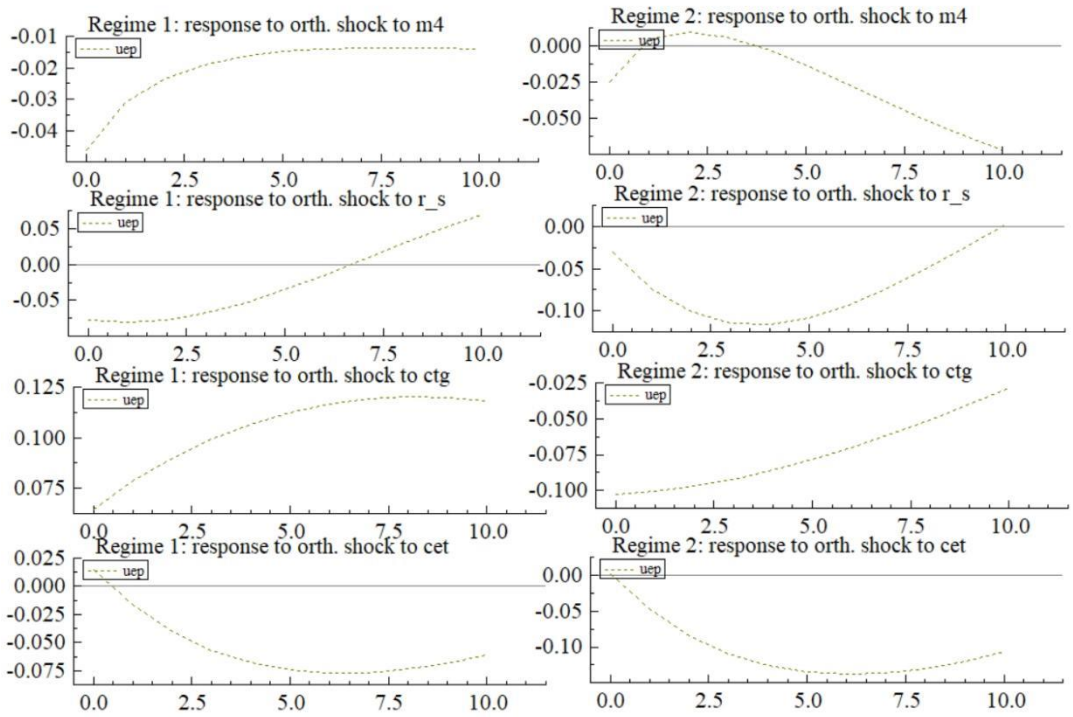


Figure 24. Impulse Responses of uep to shocks of other variables

Figure 24 also shows different results on monetary tools on unemployment rate. Increase of monetary supply general decrease unemployment rate, while in previous analysis, it will turns to positive effect after around 5 steps. Increase of interest rate tends to have more periods of negative effect on unemployment rate.

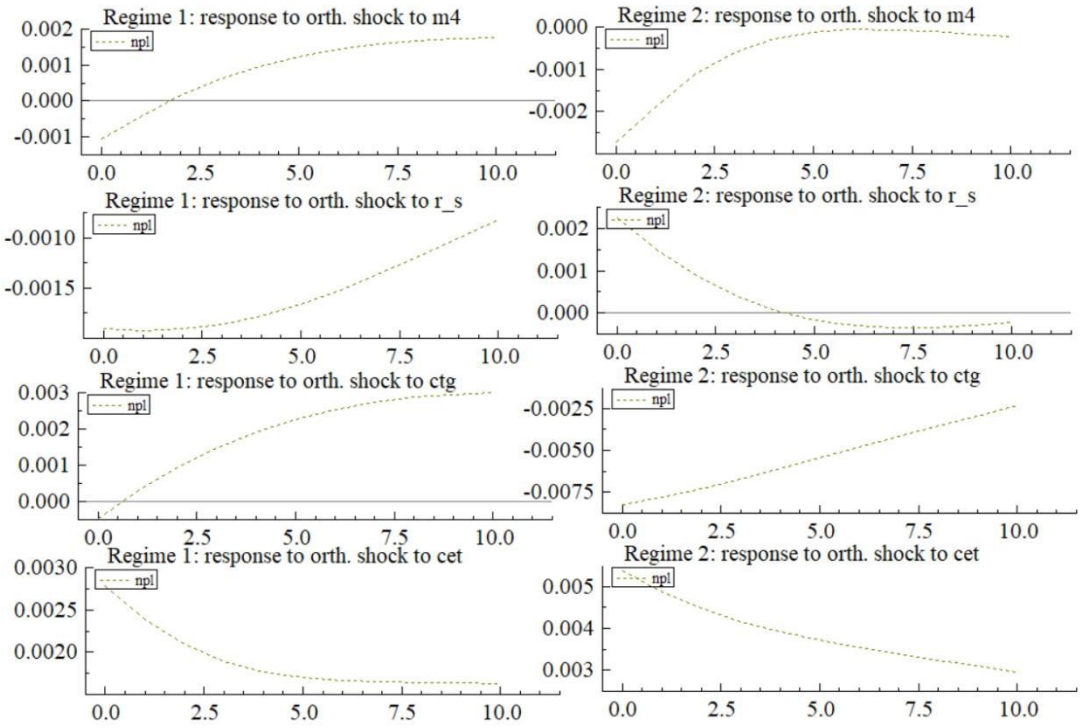


Figure 25. Impulse Responses of npl to shocks of other variables

Figure 25 shows similar results with inter-bank rate analysis. Generally, increase r can decrease non-performing loans rate.

Overall, shadow rates for UK in ms-var model can yield more reasonable results. This may be because UK has long ZLB periods and shadow rates are more effective in analyzing monetary policy effects.

US shadow rates analysis

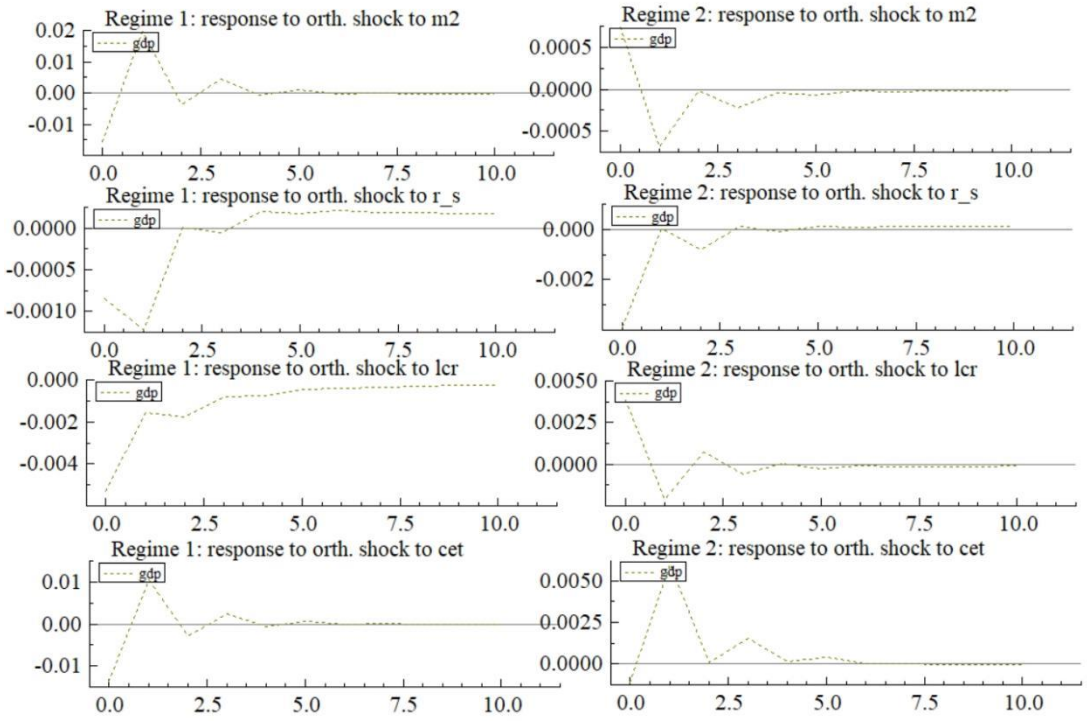


Figure 26. Impulse Responses of gdp to shocks of other variables

Figure 26 shows the ms-var results of output using shadow rate. The result is quite similar to previous inter-bank rate analysis. The r here generally has more negative effect on output under two phases than inter-bank rate.

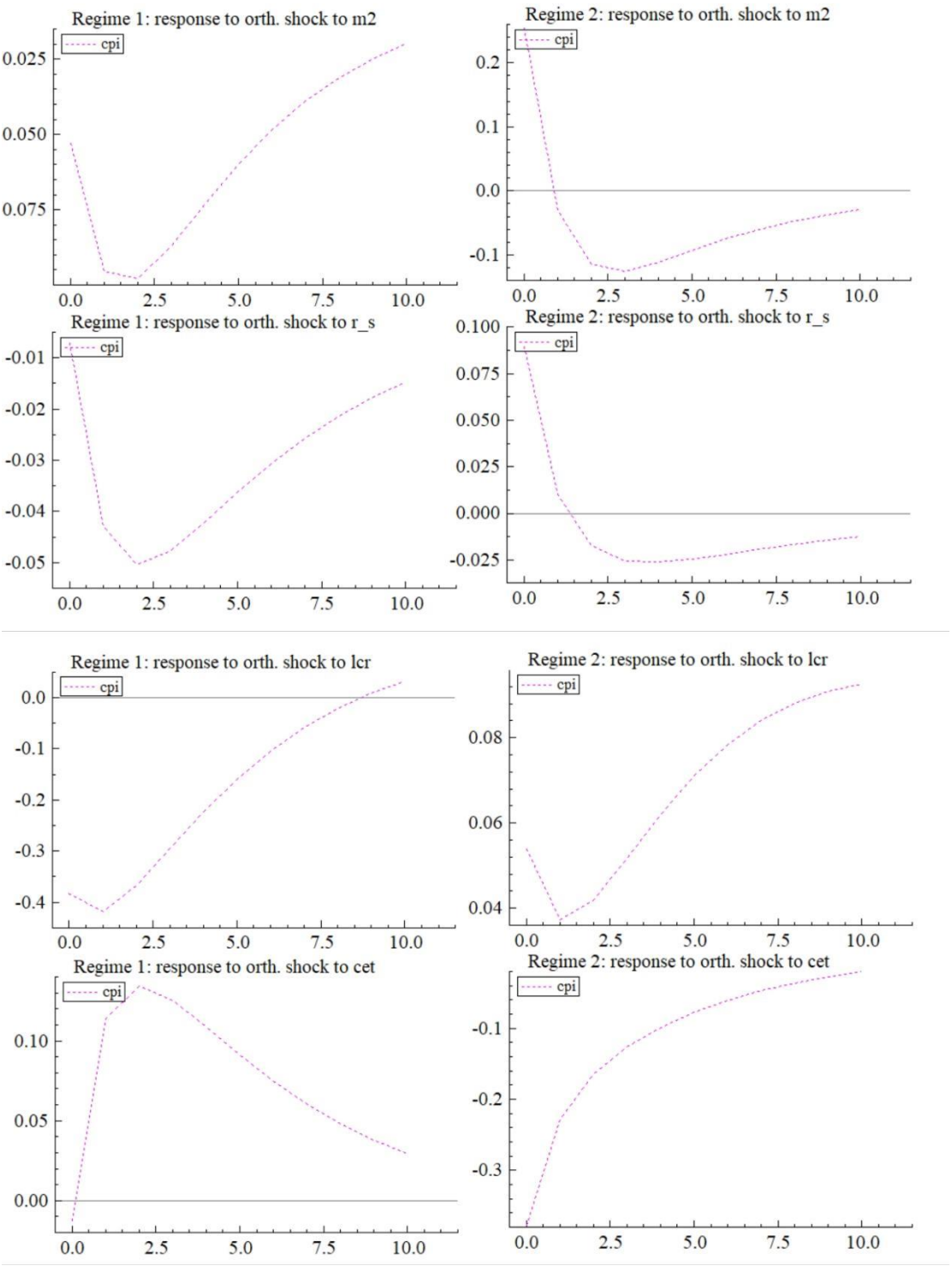


Figure 27. Impulse Responses of cpi to shocks of other variables

Figure 27 shows different results of interest rate and money supply compared to inter-bank rate analysis. In recession stage, r and M2 both have a lagged effect that they goes down to under zero after around 2 steps. In expansion phase (regime1), monetary supply has all-period positive effect and in recession stage, it will goes to a little bit under zero from positive after 2 steps and finally goes to zero. Compared to inter-bank rate, shadow rates analysis is more significant and reasonable because using inter-bank rate M2 can sometimes

be negative and r can sometimes be positive.

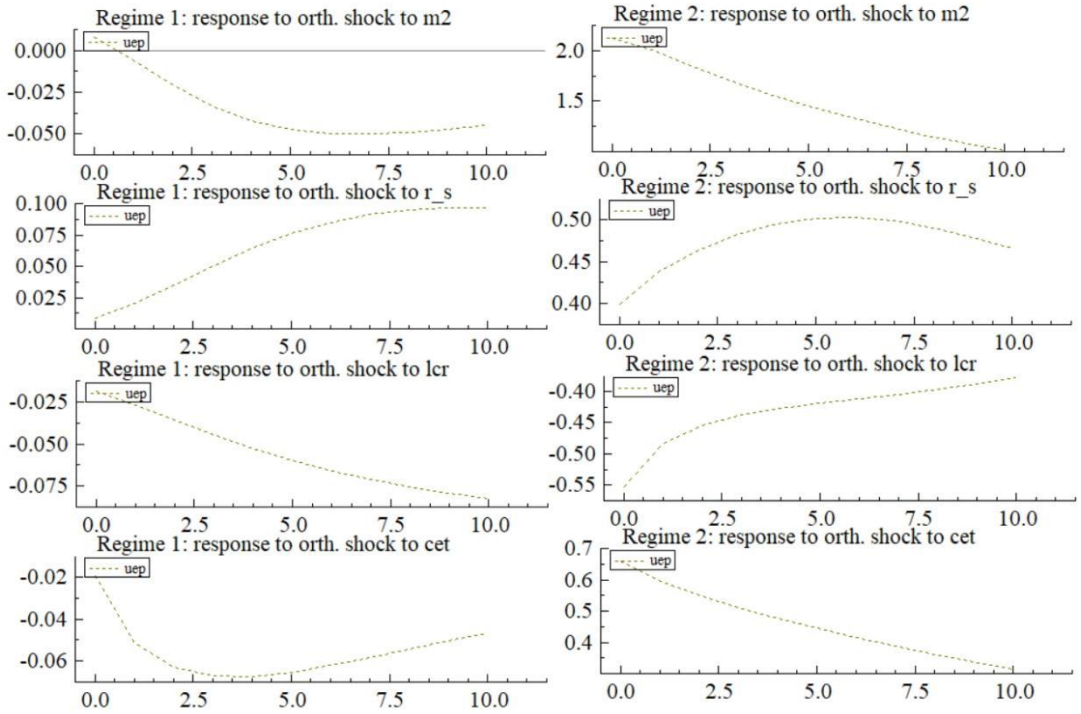


Figure 28. Impulse Responses of uep to shocks of other variables

Figure 28 shows using shadow rates can yield opposite result of r. The other variables' effect are same. Here, r_s has a positive effect on unemployment rate under two regimes while r has a negative effect. This may be because during ZLB periods, inter-bank rate didn't goes down much to under zero level. However, shadow rates can goes much lower and this reverse the results.

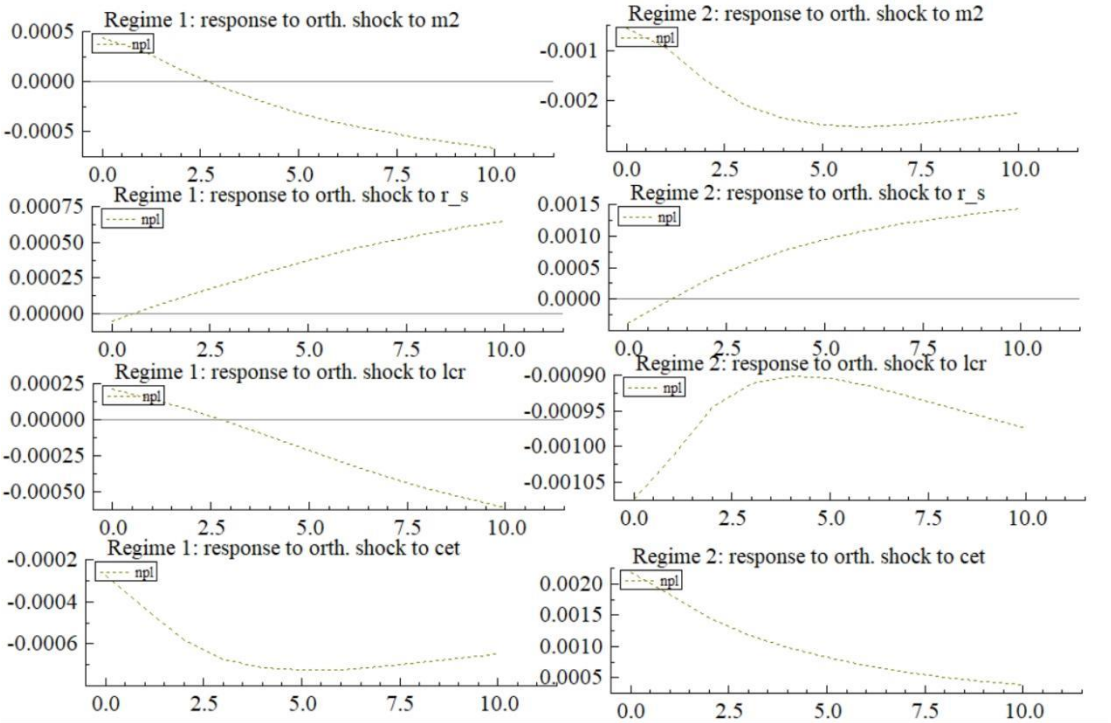


Figure 29. Impulse Responses of npl to shocks of other variables

Figure 29 and 15 shows both shadow rate and inter-bank rate have little effect on non-performing loans rate, but shadow rate's effect is positive while the inter-bank rate's effect is negative. The reduce of npl depends more on macro-tools in the US.

In conclusion, shadow rate can give more reasonable results on inflation of US. As for unemployment rate, it reverse the results of interest rate.

EU shadow rate analysis

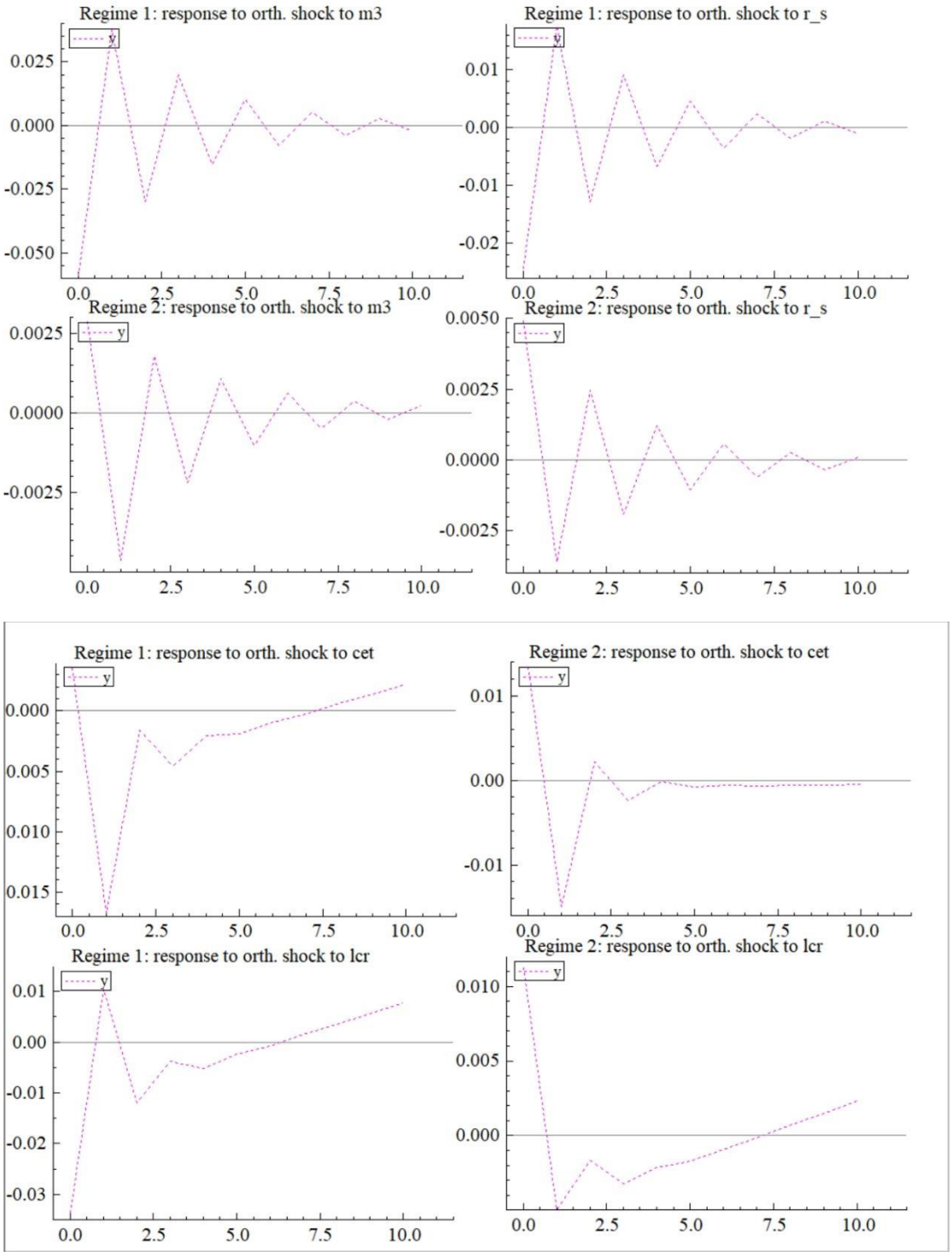


Figure 30. Impulse Responses of y to shocks of other variables

Basically, figure 30 shows similar results to inter-bank rate analysis. The only different is the intensity of M3 and r are smaller.

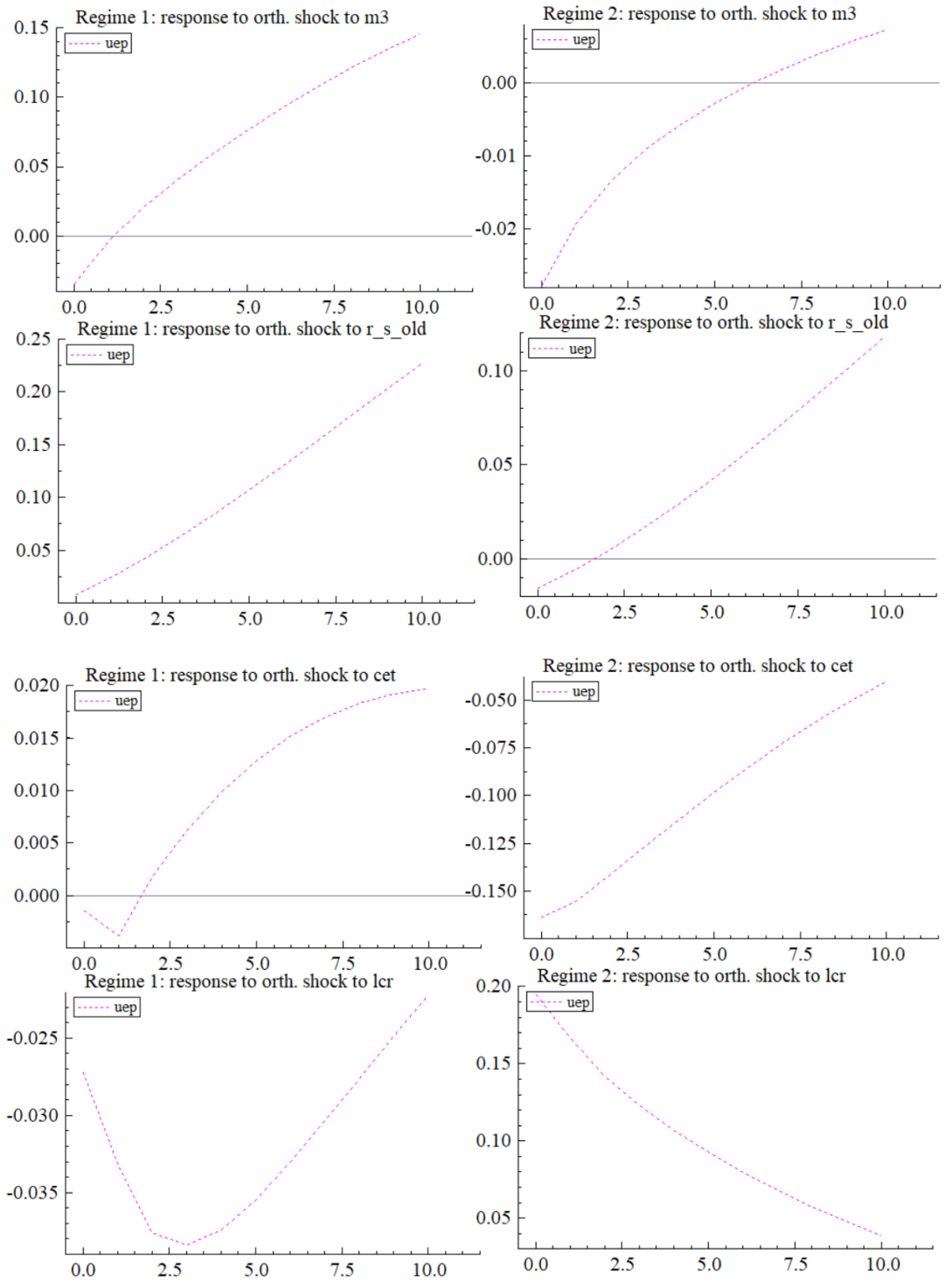


Figure 31. Impulse Responses of uep to shocks of other variables

Figure 31 shows an increase in r here can lead to increase in unemployment rate (except a negative effect at first in expansion stage), while increase inter-bank rate can decrease unemployment in expansion phase. Furthermore, response steps of money supply are also different compared to inter-bank rate analysis. M3 here will decrease uep first, but increase

uep after several steps. Macro-prudential tools' effect are basically similar. The shadow rate analysis is more reliable because Euro zone was always in ZLB periods in recent 15 years.

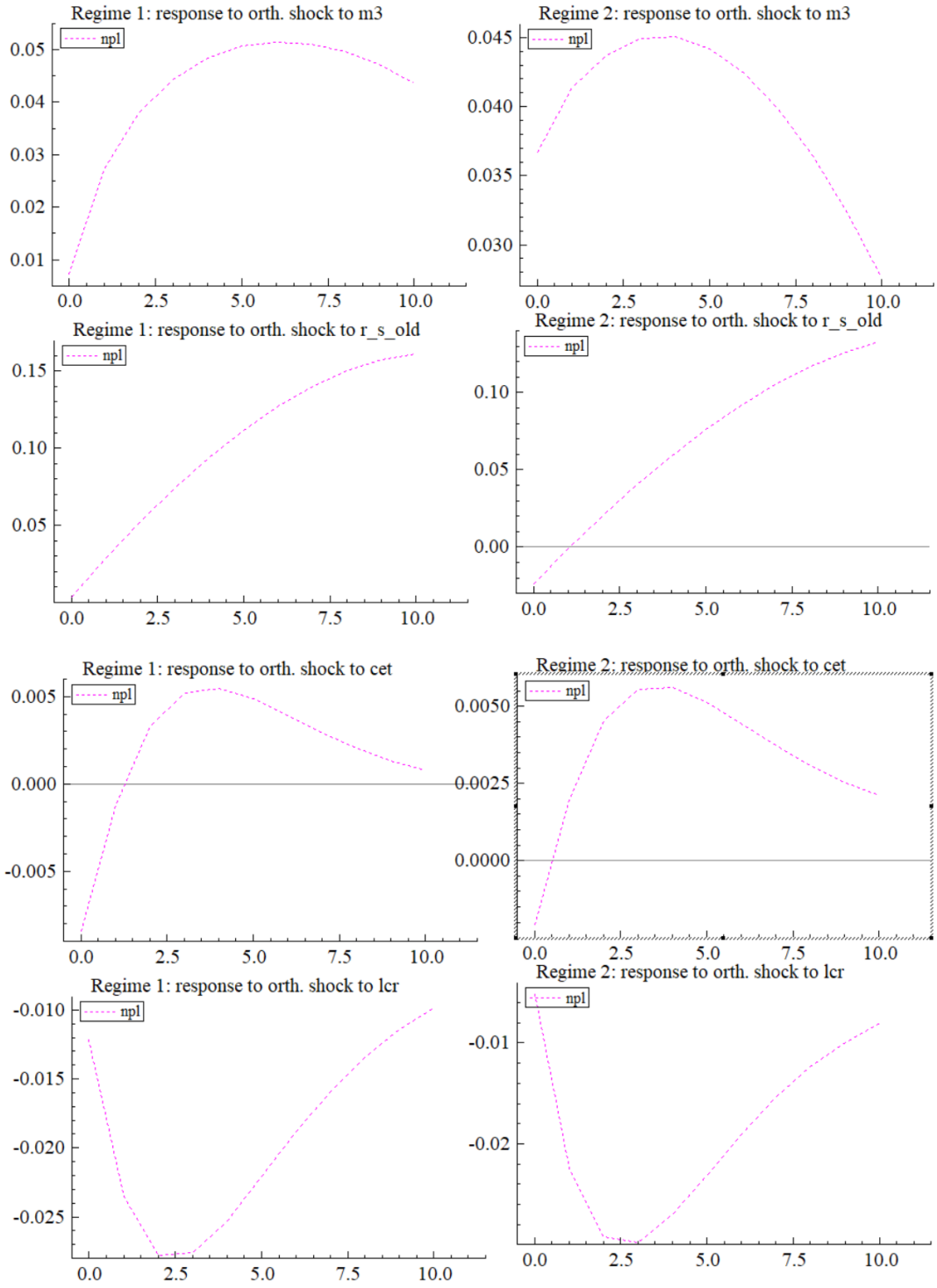


Figure 32. Impulse Responses of npl to shocks of other variables

The general results of using shadow rates in non-performing loans are similar to inter-bank rate analysis, but the steps and intensity are slight different. The money supply can lead to the rise of non-performing loans rate, but intensity is smaller than that in inter-bank rate analysis. Moreover, Interest rate here has more positive effect period. Both analysis find that reducing npl relies on macro-prudential tools.

Overall, for Euro zone, using shadow rates has some different results, but not significant. This may be because inter-bank rate of EU also always went below zero.

China shadow rate analysis

Using Wu-xia's method mentioned in Methodology part, this study yields shadow rate of China. Then replace inter-bank rates with shadow rates.

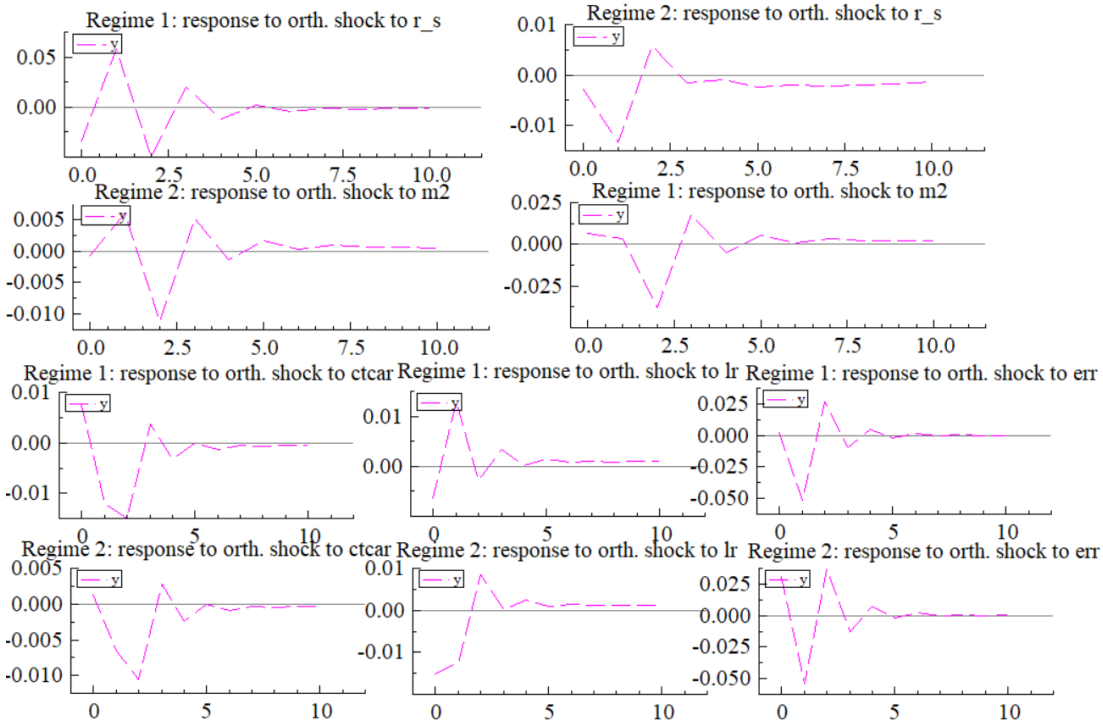


Figure 33. Impulse Responses of y to shocks of other variables

From figure 33, the response steps of all variables are generally similar. The only difference is the intensity.

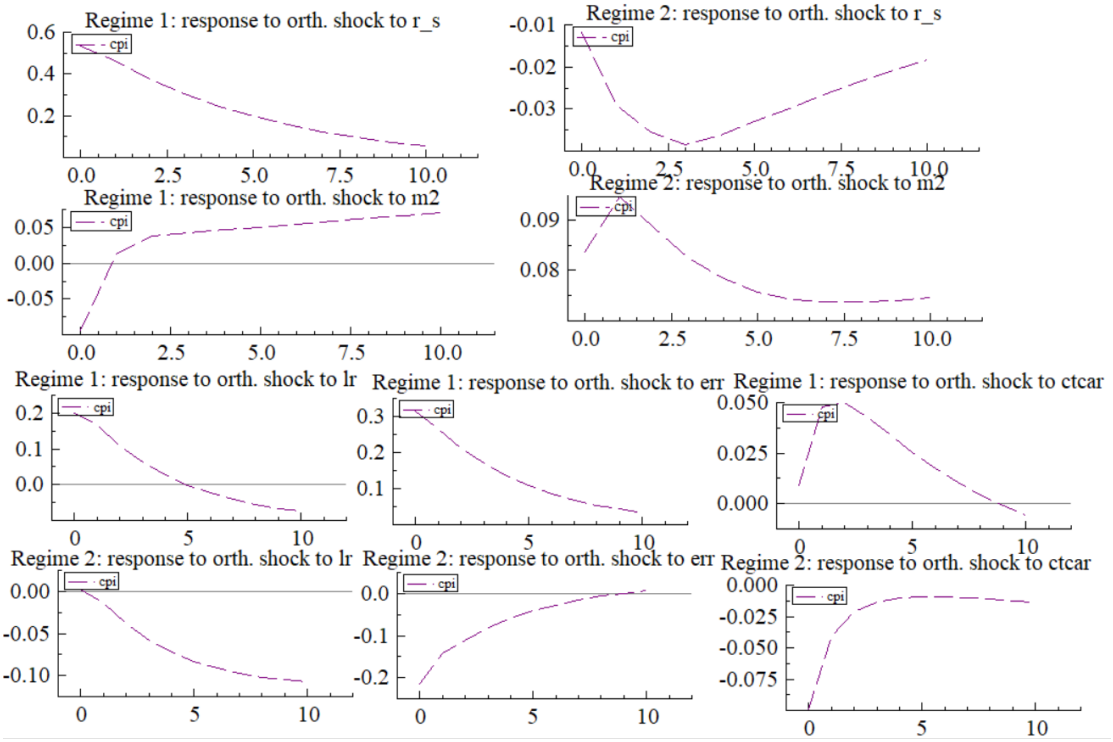


Figure 34. Impulse Responses of cpi to shocks of other variables

Based on figure 35, the results are generally similar with inter-bank rate analysis. Both r has slightly positive effect in recession stage. The increase in shadow rates yield negative effect on inflation in expansion stage (regime2), while inter-bank rate has smaller but positive effect. Also, in recession stage (regime1), money supply will turns to positive more quicker.

Overall, shadow rates analysis yield slightly different results in M2 (recession stage) and r (expansion stage) of inflation model. This may be because China nearly does not have ZLB period. The results are as expected.

5. Conclusion

This study employs an MS-VAR framework to analyze the dynamic interactions between monetary and macro-prudential policies across the US, UK, Eurozone, and China, emphasizing their effectiveness under different financial cycle phases. Using the Financial Conditions Index (FCI) to distinguish between financial expansions and contractions. The study provides nuanced insights into how monetary and macro-prudential policies operate under varying financial conditions. The findings reveal distinct patterns in financial cycles and policy effectiveness across regions, underscoring the importance of dual-pillar policy frameworks. Furthermore, this study apply shadow rates to further analyze dual-pillar policy's impact and compare the results with inter-bank rate. It finds that in UK and US, shadow rates are more suitable to analyze momentary policy tools' effect and can yield more reasonable results.

As for China, financial expansions are more stable and prolonged, where monetary policies like M2 growth and interest rate cuts effectively stimulate output and inflation, albeit

with delayed impacts in downturns. Macro-prudential measures, such as liquidity ratios and CET1 capital adequacy requirements, support stability and growth during expansions but may restrict recovery by limiting credit availability during contractions. The tightly controlled financial system enables targeted interventions, enhancing policy effectiveness.

For the UK, financial expansions dominate, with monetary policies like M4 growth showing limited benefits for output during booms but effectively supporting inflation during recessions. Interest rate cuts also exhibit greater efficacy in downturns. Macro-prudential measures, such as managing the Credit-to-GDP gap and increasing CET1 capital ratios, are critical for stabilizing financial conditions and curbing systemic risks in recessions. However, excessive tightening during expansions may constrain lending and economic growth, highlighting the need for a balanced policy approach.

In the US, monetary policy is most effective in stabilizing output and inflation during contractions, where M2 growth and interest rate cuts provide short-lived boosts to economic activity and price levels. However, during expansions, these measures have diminishing returns, potentially contributing to inefficiencies. Macro-prudential tools, such as CET1 capital ratios and liquidity requirements, play a stabilizing role, particularly during downturns, by reducing non-performing loans and supporting financial system resilience. Nonetheless, these tools can restrain growth when overly tightened in recovery phases, necessitating careful calibration.

The Eurozone experiences prolonged financial contractions, where monetary policies such as M3 expansion and interest rate cuts are moderately effective in supporting output and inflation. Macro-prudential measures, including CET1 capital ratios and liquidity coverage ratios, help stabilize financial conditions during downturns but risk dampening recovery if applied excessively. During expansions, these tools maintain financial stability but contribute less to growth, emphasizing the importance of flexible adjustments to address cyclical vulnerabilities.

The findings emphasize that the effectiveness of dual-pillar policies can be highly dependent on the financial regime and regional characteristics. Same policy measure can have different impact on response intensity and response steps of output, inflation, unemployment rate and non-performing loan rate in different countries. Policymakers must adopt flexible, region-specific strategies that align with the distinct financial cycles and economic structures of each country or region to enhance economic stability and resilience.

Reference

Abbate, A., Eickmeier, S., & Lemke, W. (2016). The changing international transmission of financial shocks: Evidence from a classical time-varying FAVAR. Journal of Money, Credit and Banking, 48(4), 573-601.

Adarov, A. (2022). Financial cycles around the world. International Journal of Finance & Economics, 27(3), 3163-3201.

Aikman, D., Giese, J., Kapadia, S., & McLeay, M. (2018). Targeting financial stability: Macroprudential or monetary policy? Bank of England Working Paper No. 734.

Akinci, O., & Olmstead-Rumsey, J. (2015). How effective are macroprudential policies? An empirical investigation. Journal of International Economics.

Angelini, P., Neri, S., & Panetta, F. (2011). Monetary and macroprudential policies. Bank of Italy Temi di Discussione Working Paper No. 801.

Angelini, P., Neri, S., & Panetta, F. (2012). Monetary and macroprudential policies. European Central Bank Working Paper Series No. 1449.

Ardila, D., & Sornette, D. (2016). Dating the financial cycle with uncertainty estimates: A wavelet proposition. Finance Research Letters, 19, 298-304.

Bailliu, J., Kartashova, K., & Meh, C. (2012). Household borrowing and spending in Canada. Bank of Canada Review, 16-29.

Bank of England. (2021). How do we monitor UK financial conditions? [Online]. Available at: Bank of England Financial Stability

Beau, D., Clerc, L., & Mojon, B. (2012). Macro-prudential policy and the conduct of monetary policy. Banque de France Working Paper No. 390.

Bernanke, B. S., Gertler, M., & Gilchrist, S. (1998). The financial accelerator in a quantitative business cycle framework. NBER Working Paper No. 6455.

Borio, C. (2014). The financial cycle and macroeconomics: What have we learnt? Journal of Banking & Finance, 45(8), 182-198.

Brave, S., & Butters, R. A. (2011). Monitoring financial stability: A financial conditions index approach. Economic Perspectives, 35(1), 22-43.

Bruno, V., Shim, I., & Shin, H. S. (2017). Comparative assessment of macroprudential policies. Journal of Financial Stability, 28, 183-202.

Cerutti, E., Claessens, S., & Laeven, L. (2017). The use and effectiveness of macroprudential policies: New evidence. Journal of Financial Stability.

Chen, S., Ma, H., & Mu, C. (2009). Research on MS-VAR model and regime of financial risk early warning in China. Jilin University Journal Social Sciences Edition, 49(1).

Chen, X., Xu, J., & Li, Y. (2011). Construction and application of China's financial conditions index. Financial Research, 5, 1-17.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary policy shocks: What have we learned and to what end? In Handbook of Macroeconomics (Vol. 1, pp. 65-148).

Claessens, S., Ghosh, S. R., & Mihet, R. (2010). Macro-prudential policies to mitigate financial system vulnerabilities. Journal of Financial Stability, 6(3), 194-215.

Claessens, S., Kose, M. A., & Terrones, M. E. (2012). How do business and financial cycles interact? Journal of International Economics, 87(1), 178-190.

Cogley, T., & Sargent, T. (2005). Drifts and volatilities: Monetary policies and outcomes in the post WWII U.S. Review of Economic Dynamics, 8(2), 262-302.

Collard, F., Dellas, H., Diba, B., & Loisel, O. (2017). Optimal monetary and prudential policies. American Economic Journal: Macroeconomics, 9(1), 40-87.

Cobas, O., Davis, E. P., & Pascual, R. (2016). Macroprudential tools, transmission and modelling. National Institute of Economic and Social Research Discussion Papers.

Darracq Pariès, M., Maurin, L., & Moccero, D. (2014). Financial conditions index and credit supply shocks for the euro area. ECB Working Paper Series No. 1644.

Disyatat, P. (2010). Inflation targeting, asset prices, and financial imbalances: Contextualizing the debate. Journal of Financial Stability, 6(3), 145-155.

Drehmann, M., Borio, C., & Tsatsaronis, K. (2012). Characterising the financial cycle: Don't lose sight of the medium term! BIS Working Papers No. 380.

English, W., Tsatsaronis, K., & Zoli, E. (2005). Assessing the predictive power of measures of financial conditions for macroeconomic variables. BIS Papers, 22, 228-252.

Fahr, S., & Fell, J. (2017). Macroprudential policy – closing the financial stability gap. Journal of Financial Regulation and Compliance, 25(4), 334-359.

Federal Reserve Bank of Chicago. National Financial Conditions Index (NFCI). Available at: Chicago Fed NFCI

Federal Reserve Bank of Kansas City. Kansas City Financial Stress Index (KCFSI). Available at: KCFSI

Fisher, I. (1933). The debt-deflation theory of great depressions. Econometrica, 1(1), 337-357.

Fouejieu, A., Popescu, A., & Villieu, P. (2019). Trade-offs between macroeconomic and financial stability objectives. Economic Modelling, 81, 621-639.

Galati, G., & Moessner, R. (2013). Macroprudential policy – a literature review. Bank for International Settlements Papers No. 48.

Galati, G., Hindrayanto, I., Koopman, S. J., & Vlekke, M. (2016). Measuring financial cycles in a model-based analysis: Empirical evidence for the United States and the euro area. Economics Letters, 145, 83-87.

Gauthier, C., Graham, C., & Liu, Y. (2004). Financial conditions indexes for Canada. Bank of Canada Working Paper No. 2004-22.

Gertler, M. (2009). Financial intermediation and credit policy in business cycle analysis. In Handbook of Monetary Economics.

Goodhart, C., & Hofmann, B. (2000). Do asset prices help to predict consumer price inflation? Journal of Monetary Economics, 46(1), 25-53.

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. Econometrica, 57(2), 357-384.

Hatzius, J., Hooper, P., Mishkin, F. S., Schoenholtz, K. L., & Watson, M. W. (2010). Financial conditions indexes: A fresh look after the financial crisis. NBER Working Paper No. 16150.

Hiebert, P., Jaccard, I., & Schüler, Y. (2018). Contrasting financial and business cycles: Stylized facts and candidate explanations. Journal of Financial Stability, 38, 72-80.

Jordà, Ò., Schularick, M., & Taylor, A. M. (2013). When credit bites back. Journal of Money, Credit and Banking, 45(s2), 3-28.

Kannan, P., Rabanal, P., & Scott, A. M. (2012). Monetary and macroprudential policy rules in a model with house price booms. Journal of Macroeconomics, 34(3), 713-725.

Kapetanios, G., & Price, S. (2017). A UK financial conditions index using targeted data reduction. Journal of Financial Stability, 28, 203-224.

Kashyap, A. K., Stein, J. C., & Hanson, S. (2010). An analysis of the impact of "substantially

heightened" capital requirements on large financial institutions. Harvard Business School.

Kindleberger, C. P. (1978). Manias, panics, and crashes: A history of financial crises. New York: Basic Books.

Kremer, M., Lo Duca, M., & Holló, D. (2012). CISS - A composite indicator of systemic stress in the financial system. ECB Working Paper Series No. 1426.

Krolzig, H.-M. (1997). Markov-switching vector autoregressions: Modelling, statistical inference, and application to business cycle analysis. Berlin: Springer.

Laeven, L. (2011). Banking crises: A review. Annual Review of Financial Economics, 3(1), 17-40.

Lim, C. H., Krznar, I., Lipinsky, F., Otani, A., & Wu, X. (2011). Macroprudential policy: What instruments and how to use them? Lessons from country experiences. IMF Working Papers WP/11/238.

Lütkepohl, H. (2005). New introduction to multiple time series analysis. Berlin: Springer-Verlag.

Matheron, J., & Antipa, P. (2014). Interactions between monetary and macroprudential policies. Financial Stability Review, 18, 225-240.

Plašil, M., Seidler, J., & Hlaváč, P. (2016). A new measure of the financial cycle: Application to the Czech Republic. Eastern European Economics, 54(4), 296-318.

Rubio, M., & Carrasco-Gallego, J. A. (2015). Macroprudential and monetary policy rules: A welfare analysis. Manchester School, 83(2), 127-152.

Rubio, M. (2016). Short and long-term interest rates and the effectiveness of monetary and macroprudential policies. Journal of Macroeconomics, 47, 103-115.

Schüler, Y. S., Hiebert, P. P., & Peltonen, T. A. (2015). Characterising the financial cycle: A multivariate and time-varying approach. ECB Working Paper No. 1846.

Sims, C. A., & Zha, T. (2006). Were there regime switches in U.S. monetary policy? American Economic Review, 96(1), 54-81.

Stock, J. H., & Watson, M. W. (2001). Vector autoregressions. Journal of Economic Perspectives, 15(4), 101-115.

Suh, H. (2012). Macroprudential policy: Its effects and relationship to monetary policy. Federal Reserve Bank of Philadelphia Working Paper No. 12-28.

Tian, S. M., & Lu, C. Y. (2019). Research on the dynamic influence of financial cycle to Chinese macroscopical economy. Exploration of Economic Problems, 2019(06), 1-8.

Unsal, D. F. (2013). Capital flows and financial stability: Monetary policy and macroprudential responses. International Journal of Central Banking, 9(1), 233-285.

Woodford, M. (2012). Inflation targeting and financial stability. NBER Working Paper No. 17967.

Wu, J., Wang, L., & Li, M. (2015). Construction and application analysis of China's financial conditions index. Economic Research, 12, 120-132.

Wu, J.C. and Xia, F.D., 2016. 'Measuring the macroeconomic impact of monetary policy at the zero lower bound', Journal of Money, Credit and Banking, 48(2-3), pp.253-291.

Zhang, L., & Zoli, E. (2016). Leaning against the wind: Macroprudential policy in Asia. Journal of Asian Economics, 42, 33-52.

Zhang, Y. (2013). Construction and application of China's financial conditions index in monetary policy. Financial Development Review, 3, 23-34.

Zdzienicka, A., Chen, S., Kalan, F. D., Koloskova, K., & Laseen, S. (2016). Effects of monetary and macroprudential policies on financial conditions: Evidence from the United States. IMF Working Papers No. 15/288.

APPENDIX

Table 1: Stationarity Test Results for China

Variable	P-Value	Conclusion
Y	0.0144	Stationary
fci	0.0010	Stationary
m2	0.0019	Stationary
R	0.0000	Stationary
Lr	0.0011	Stationary
err	0.0000	Stationary
ctcar	0.0003	Stationary

Table 2: Stationarity Test Results for UK

Variable	P-Value	Conclusion
y	0.002	Stationary
fci	0.0485	Stationary
M4	0.0099	Stationary
r	0.01	Stationary
ctg	0.0159	Stationary
cet	0.0267	Stationary
npl	0.0222	Stationary

Table 3: Stationarity Test Results for US

Variable	P-Value	Conclusion
y	0.02	Stationary
fci	0.0143	Stationary
m2	0.0416	Stationary
r	0.0185	Stationary
lcr	0.0148	Stationary
npl	0.0276	Stationary
cet	0.0079	Stationary

Table 4: Stationarity Test Results for Euro zone

Variable	P-Value	Conclusion
y	0.0215	Stationary
fci	0.0119	Stationary
M3	0.0069	Stationary
r	0.0175	Stationary
npl	0.0472	Stationary
cet	0.0168	Stationary