

The Effects of Macroprudential and Monetary Policy Shocks in BRICS economies

by **Kaelo Mpho Ntwaepelo**

[Discussion Paper](#) No. 2021-19

Department of Economics
University of Reading
Whiteknights
Reading
RG6 6AA
United Kingdom

www.reading.ac.uk

The Effects of Macroprudential and Monetary Policy Shocks in BRICS economies

Kaelo Mpho Ntwaepelo[‡]

November 2021

Abstract

This paper examines the macroeconomic effects of the macroprudential and monetary policy shocks, in a framework where the policies target both the price and financial stability objectives. I employ the system-generalised method of moments (system-GMM) technique in a dynamic panel data model, over the 1990-2016 period. The study uses the novel integrated macroprudential policy dataset (iMaPP) in the context of the five major emerging market economies: Brazil, Russia, India, China and South Africa (BRICS). The results indicate that a contractionary monetary policy shock eliminates the excessive growth of credit and house prices but increases the price levels (price puzzle). The presence of a price puzzle after a contractionary monetary policy shock indicates that there is a trade-off between the financial stability and price stability objectives. Similarly, the impulse response function analysis reveals the presence of a negative correlation between the financial variables and output, after a contractionary macroprudential policy shock. Overall, the empirical findings suggest that there is a policy conflict when the policies respond to additional objectives beyond their primary targets. It is therefore beneficial for each policy to focus on its primary objective while considering the spillover effects of the other policy.

JEL Classification: E58, E61, G28

Keywords: emerging markets; macroprudential policy; financial stability; monetary policy; price stability

*Department of Economics, University of Reading, Whiteknights, Reading RG6 6AA.
E-mail: k.m.ntwaepelo@pgr.reading.ac.uk

[‡]I am grateful to my supervisors Dr. Alexander Mihailov and Dr. Mark Guzman, Department of Economics, University of Reading, United Kingdom for their valuable suggestions. I am also thankful to Dr. Carl Singleton, Dr. Stefania Lovo, Dr. Tho Pham and the participants of the PhD seminar at the University of Reading and Royal Holloway, University of London for their helpful comments. This paper benefits from the package of programs shared by Professor Inessa Love. The views expressed in this paper are those of the author and do not necessarily reflect those of the Bank of Botswana.

1 Introduction

Prior to the 2007-2008 global financial crisis, policymakers mainly focused on achieving the price stability objective and little or no attention was given to financial stability issues. The repercussions of the financial crisis however, highlighted that financial instability can have negative effects on the traditional macroeconomic objective¹ (Smets, 2014). This therefore prompted central banks to reconsider their objectives and to actively pursue macroprudential policy², in order to contain financial imbalances (Richter et al., 2018). Even though reference to the term "macroprudential" became common after the 2007-2008 global financial crisis, the concept can be traced back to the 1970s when the Basel Committee³ (Clement, 2010) suggested that financial regulation should have a systematic macroeconomic perspective. The use of macroprudential policies initially began in the advanced economies. However, emerging market economies also utilised the policies in the 1990s to mitigate the financial imbalances linked to excessive capital inflows. The capital inflows were mostly caused by exchange rate misalignments and excessive credit growth during the great moderation era when most advanced economies invested in emerging market economies, in a search for higher yields. Following the 2007-2008 global financial crisis, the Bank for International Settlements (BIS), the Financial Stability Board (FSB) and the International Monetary Fund (IMF) used the term to specifically refer to the regulation and supervision of the financial system to prevent the disruption of financial services in the macroeconomy (Borio, 2009).

Unlike monetary policy, which has an economy-wide impact with the main objective of stabilising prices and output, macroprudential policy specifically targets the financial sector and aims to achieve financial stability by preventing excessive asset price and credit growth⁴. Macroprudential policy therefore maintains the financial sector resilience to economic shocks and ensures that banks perform their lending function even during periods of a financial crisis (Kim and Mehrotra, 2019). In this regard, monetary policy may be a costly tool for addressing sector-specific shocks, especially those that stem from the financial sector (Hanson et al., 2011). Post the global financial crisis, policymakers adopted the use of macroprudential policy tools, to complement monetary policy and achieve overall economic stability. However, a counter-cyclical management policy framework that includes both macroprudential and monetary policies, raises important coordination issues. This is mainly because even though the policies differ in terms of their primary objectives and policy instruments, they are bound to interact with each other as they both affect the financial system in their transmission mechanisms (Beau et al., 2012). It is therefore worthwhile to examine the macroeconomic effects of the policy shocks and establish whether there are potential spillovers and differences in their effectiveness to achieve the price and financial stability objectives in the BRICS⁵ economies.

This paper takes its cue from the fact that monetary policy measures that are aimed at achieving price and output stability can interfere with the financial stability objective through the interest rate channel (Bruno et al., 2017). This is particularly because changes in the monetary policy interest rate affect the cost of credit and consequently the demand for credit. Similarly, the effect of macroprudential policy instruments

¹The traditional macroeconomic objective in most economies is price and output stability.

²Countries use a variety of macroprudential policy tools including credit-related, liquidity-related and capital-related measures to address financial imbalances and the choice of instruments depend on the country's degree of economic and financial development and vulnerability to shocks.

³The banking supervisory authority established in 1974.

⁴The macroprudential policy authority achieves the financial stability objective by tightening the macroprudential policy instruments when there is excess credit or asset price growth in the economy and eases the policy tools when there is a financial shock.

⁵The acronym refers to Brazil, Russia, India, China and South Africa.

on financial stability may affect other parts of the economy, such as output and inflation. Despite the growing literature in this research area, there is still no consensus about the macroeconomic effects of the two policies, especially in emerging market economies. The lack of consensus is in part due to the recent use of macroprudential policy and the challenge of quantifying the various macroprudential policy measures. The effects of the policy on the real economy and the financial sector is therefore not well understood (Rubio and Carrasco-Gallego, 2016). This therefore poses some problems for policymakers on how to successfully implement and coordinate monetary and macroprudential policies, in order to achieve a desirable policy mix. I therefore contribute to the existing literature by shedding more light on the macroeconomic effects of the two policies in a setting of the five major emerging market economies, using the novel integrated macroprudential policy (iMaPP) dataset by Alam et al. (2019), released in March 2019. Considering that most of the findings in the existing literature are based on a dataset by Shim et al. (2013), addressing the research question using Alam et al. (2019)'s dataset, therefore allows for more comprehensive insights. This is because the dataset by Shim et al. (2013) has a narrow scope and only focuses on macroprudential measures that target housing credit. In comparison, the iMaPP dataset covers 17 macroprudential policy instruments in 134 countries and consolidates data from five major existing macroprudential databases and the annual global survey of macroprudential measures by the International Monetary Fund (IMF). To the best of my knowledge, no previous study has utilised the dataset for the case of the BRICS economies. The focus on the BRICS economies is important because even though the countries have a lot of experience using the macroprudential policy instruments, the discussions around this topic in the literature is centred around advanced economies. Emerging economies have had greater experience with the use of macroprudential policy instruments because of their pronounced financial and business cycles, given their exposure to commodity price shocks and capital flow volatility (Claessens et al., 2012). This renders the investigation about the effects of the policies in these economies even more important given that their policy trade-offs are more complex (Tobal and Menna, 2020). Furthermore, studying the dynamics of the policies within a uniform economic set-up is vital as it gives more conclusive results in the context of emerging economies. Kim and Mehrotra (2017) emphasise that the effects of macroprudential policy are largely dependent on the level of financial development in a country. A study by Cerutti et al. (2016) also confirms that this is an important factor for macroprudential policy to effectively curb credit growth. It is therefore important to explore this research topic for a group of countries that belong to the same economic classification and provide a learning experience for other economies, especially developing countries.

In order to examine the macroeconomic effects of the policy shocks on the target variables⁶, I employ a panel vector autoregression (PVAR) estimation technique combined with the system-generalised method of moments (system-GMM) to capture the policy domain, the financial sector and the real economy. I then derive the impulse response functions for the period spanning 1990 to 2016. I use the results to establish if it is ideal for monetary policy to "lean against the wind"⁷ and achieve the financial stability objective, in addition to price stability, in the BRICS economies.

The main findings of my empirical analysis suggest that when monetary policy has a dual mandate of price stability and financial stability, a contractionary shock in the policy results in a negative correlation between inflation and the financial variables. More specifically, even though a contractionary monetary policy shock in the BRICS economies can effectively reduce financial imbalances by regulating the growth

⁶Real gross domestic product (GDP) and consumer price index (CPI) are the primary target variables for monetary policy, while macroprudential policy primarily targets credit and house prices to achieve financial stability.

⁷Monetary policy is considered to lean against the wind when the policy interest rate is higher than normally required to achieve the price stability objective. In this case, the tighter than usual monetary policy is implemented for financial stability purpose (Svensson, 2017).

of credit and house prices, it compromises the price stability objective. This policy conflict implies that it is not recommended for monetary policy to "lean against the wind" of asset price and credit bubbles because the response of the policy interest rate that is required to achieve price stability is inconsistent with that required to attain financial stability.

On the other hand, a contractionary macroprudential policy shock reduces the growth of credit and house prices, but results in an increase in output and has no effect on inflation. The empirical evidence implies that although macroprudential policy in the BRICS economies achieves its primary mandate of financial stability, it does not enhance the effectiveness of monetary policy. The dynamics of the results indicate that in order for policymakers to simultaneously achieve price stability and financial stability, each policy should focus on its primary objective while taking into account the spillover effects on the other policy.

There is extensive literature that acknowledges the potential value of macroprudential instruments and their effects on the financial sector⁸. For instance, the analysis by [Claessens and Valencia \(2013\)](#) suggests that macroprudential policy can be an important element of the policy framework aimed at reducing financial sector imbalances. The study concludes that most of the macroprudential policy tools are effective in reducing the excessive growth of financial sector variables, such as: credit and asset prices. However, the shortfall of this kind of policy analysis is that it can overlook or miss the trade-off that exists between price stability and financial stability and may therefore be less informative to policymakers. On this note, there is an emerging strand of literature that explores how macroprudential policy interacts with monetary policy (see, for example, [Kim and Mehrotra, 2019](#); [Nielsen, 2019](#); [Smets, 2014](#)). The general conclusion of these studies is that, combining both policies is more effective in enhancing the overall economic stability, especially when there are financial shocks in the economy.

[Claessens and Valencia \(2013\)](#) claim that even though most of the emerging market economies have been at the forefront of using macroprudential policy instruments, research on these countries remains scarce. The work of [Liu and Molise \(2020\)](#) is one of the very few studies that provide insights on how the two policies interact in an emerging economy. [Liu and Molise \(2020\)](#) document their findings for South Africa using the dynamic stochastic general equilibrium (DSGE) framework where borrowers in the various sectors of credit co-exist. Their estimates confirm earlier findings that the deployment of both macroprudential and monetary policies, enhance the attainment of price and financial stability. Similar to this study, the authors do not support the "leaning against the wind" narrative due to its undesirable consequences on price stability. The findings by [Liu and Molise \(2020\)](#) are also similar to the evidence from other studies that advocate for a separation of responsibilities for macroprudential and monetary policies (see, for example, [Suh, 2014](#); [Gelain et al., 2013](#); [Turdaliev and Zhang, 2019](#); [Svensson, 2017](#)).

The remainder of the paper is structured as follows: Section 2 gives an overview of the BRICS countries, while Section 3 reviews the theoretical and empirical literature; Section 4 discusses the panel data used in the study and the estimation technique. The empirical evidence is discussed in Section 5; Section 6 analyses the findings from the sub-sample; Section 7 conducts the sensitivity analysis; and Section 8 concludes.

⁸Amongst others, see [Bruno et al. \(2017\)](#); [Dell’Ariccia et al. \(2011\)](#); [Igan and Kang \(2011\)](#); [Kuttner and Shim \(2016\)](#).

2 An overview of the BRICS countries

BRICS comprises of five emerging market economies, namely: Brazil, Russia, India, China and South Africa. In addition to their membership to the G20⁹, the common factor amongst these countries is the size of their economies and their economic potential. Over the years, the role of these countries in the global trading system has increased and they are expected to dominate the supply of raw materials and manufactured goods by the year 2050. The group was created in 2008 and initially consisted of only four countries (BRIC). South Africa joined the economic bloc of emerging economies in 2010. Even though South Africa has a smaller population and economy compared to the other four members, there are several factors that worked in its favour, in order for it to gain membership. These include; its advanced regulatory frameworks and banking system, innovation and well-established infrastructure (Kutu and Ngalawa, 2016).

Even though the five countries differ in terms of their languages, culture and their contributions to the group, the common objective of the economic bloc is to strengthen financial development and industrialisation among the countries. This is evident in their effort to form the New Development Bank (BRICS), as a way to offer an alternative to the World Bank and the International Monetary Fund (IMF). The bank was set up in 2015 and is located in Shanghai, China, with the objective to finance development projects across the BRICS countries and developing economies. Their contributions in the global economy are diverse. The agricultural sector in Brazil is one of the fastest growing in the world; while Russia has the largest production of gas and oil in the world; India on the other hand, is branded as the second largest producer of telecommunications in the world; China produces manufactured goods on a large scale and South Africa has vast mineral resources (Kutu and Ngalawa, 2016). The countries have therefore often been considered to have a lot of potential for investment and are often viewed as providing an alternative source of funds for development, considering that they do not follow the conventional liberalisation policy guidelines of the Washington consensus¹⁰. Despite the fact that the BRICS countries do not have formal trade agreements, the leaders of these countries act in the interest of each other and in the past, Wilson and Purushothaman (2006) highlighted that if the countries develop and maintain policies that are supportive of economic growth, they have the potential to be wealthier than the G7 countries¹¹.

In 2008 when the BRICS economic grouping was established, the countries had the greatest potential to achieve high economic growth. However, over the years, the economies have experienced severe economic woes. Mainly because of the surge in debt burden following the increase in the federal rate and a decline in the commodity prices, which has adversely affected some of the economies that heavily rely on commodity exports. The performance of the economies has therefore drastically declined over the years with China and India being the main drivers of the economic growth in the grouping, as evident in Figure 1. In 2016, India and China recorded the highest GDP growth rates in the economic grouping, at 8.3 percent and 6.8 percent, respectively. The 8.3 percent annual growth recorded in India is because the country is a net importer of commodities, whose prices declined over the years. In addition, India escaped the resource curse evident in Brazil, Russia and South Africa because it does not rely on commodity exports for its economic growth.

⁹G20 is an economic bloc of 20 countries with the aim of coordinating economic policies and accounts for about 80 percent of the global GDP. It consists of 20 members, namely; Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, United States, and the European Union (Yoon and Kim, 2013).

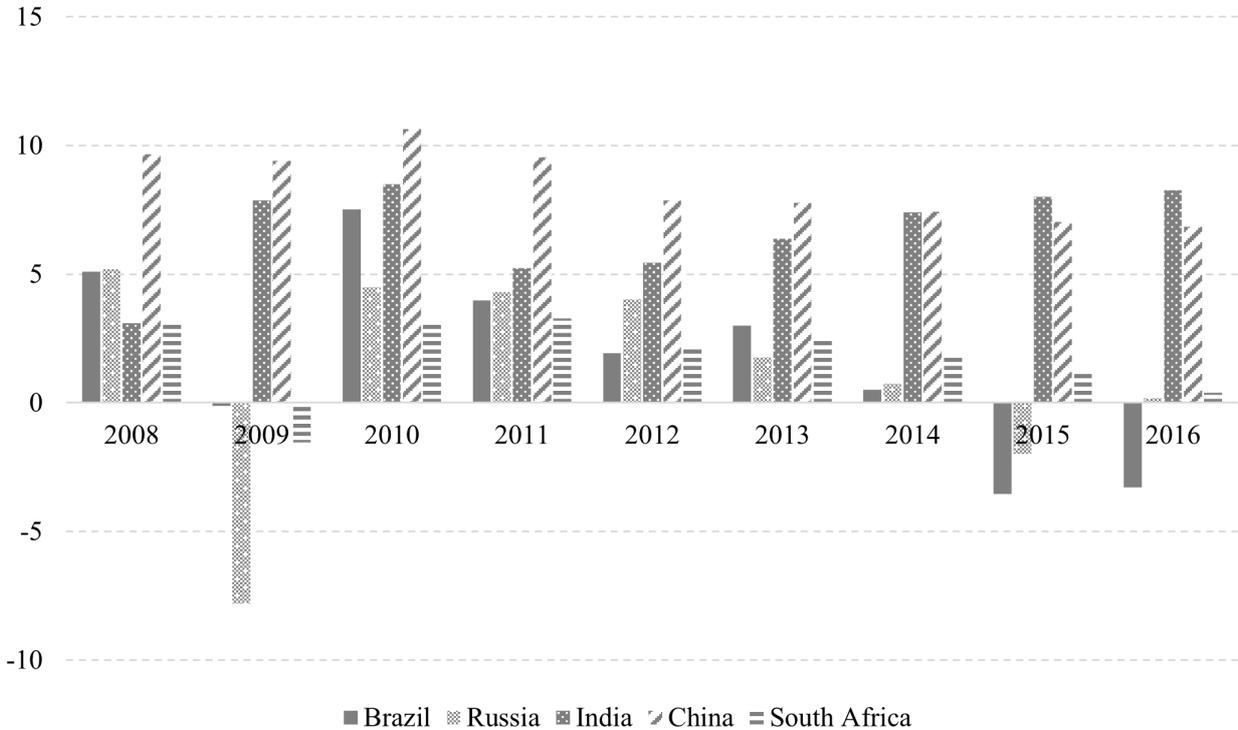
¹⁰The consensus is an outline of structural reforms such as, free trade and free-floating exchange rate (Agarwal et al., 2018).

¹¹G7 is an economic bloc of seven industrialised economies which consists of; Canada, France, Germany, Italy, Japan, the United Kingdom and the United States (Yang et al., 2012).

Comparatively, the three countries are too dependent on commodity exports and therefore need to diversify their economies by growing the role of the private sector to catch up with India and China.

Even though China has been the best performer amongst the BRICS economies, India has also managed to maintain its positive economic performance over the years by keeping its debt ratio at a sustainable level. On the contrary, Brazil and South Africa have experienced the highest debt-to-GDP ratios which negatively affected their economic performance over the decades. During the first few years as a BRICS country (from 2008 to 2013), Brazil maintained positive economic growth and met economic expectations. However, in 2015 and 2016, Brazil experienced an economic recession which saw the country’s GDP growth decline by 3.5 percent and 3.3 percent, respectively, mainly due to high inflation rates and government debt (Figure 1). The severe economic conditions in Brazil which required the implementation of a contractionary monetary policy resulted in a prolonged and severe recession. Similarly, South Africa has also experienced a deterioration in economic performance over the years due to high government debt and subdued commodity prices. The government debt rose from 30 percent in 2010 to 51 percent in 2016. On the other hand, the economic challenges that have contributed to a decline in GDP growth in Russia include the lack of economic diversification which increased the country’s exposure to external shocks. Russia is largely dependent on the export of gas and oil and the slowdown in the prices of these commodities over the years has resulted in production cuts which largely reduced the main source of revenue for the country. Overall, the considerable differences in the economic outlooks amongst the BRICS economies magnifies the divergence in their economic trajectories (Vieira and da Silva, 2021).

FIGURE 1: Annual GDP growth (%) for BRICS economies, 2008 - 2016



Notes.- The annual GDP growth rate for BRICS economies over the 2008 - 2016 period, measured in percentage. The graph suggests that since the inception of BRICS in 2008, China and India have shown strong potential growth. This is mainly because the two economies are not reliant on commodity exports.
Source: World Bank database

3 Literature Review

3.1 Theoretical Literature: Theory of Economic Policy

This study utilises the effective assignment principle by [Tinbergen \(1952\)](#). It is the principle of effective policy which distinguishes between policy targets and instruments. The theory emphasises that, each policy instrument should be assigned to only one objective and most importantly, it should be the objective which it has the most comparative advantage in achieving ([Smets, 2014](#)). This therefore suggests that the focus of the monetary policy instrument should be the attainment of price and output stability while macroprudential policy instruments are better suited to maintain financial stability ([Krug, 2018](#)).

The principle therefore favours the view that monetary policy authorities should exclusively employ the policy interest rate to achieve price and output stability because the monetary policy tool may not be successful in achieving financial stability. For example, if a negative demand shock hits the economy, the response of the central bank is to implement accommodative monetary policy, by decreasing the policy interest rate. However, if the central bank authorities want to simultaneously manage the credit growth levels from accommodative monetary policy, they may have to use macroprudential policy instruments to keep credit growth at a prudent level. Even though there are possible trade-offs from the policy actions by the central bank, it depends on whether the two policies are complements or substitutes ([da Silva, 2016](#)).

[Svensson \(2012\)](#) also argues that central banks should not use monetary policy as the first defence against financial instability. The author emphasises that, defying the Tinbergen principle may result in an overburdened monetary policy and thus have destabilising effects on the primary objectives of monetary policy. The overall expectation from the theory is therefore that the implementation of the financial stability objective as an addition to the traditional goals of monetary policy may jeopardise the policy outcomes.

Given the non-unanimous mindset among academics and policymakers on how to successfully implement the two policies, it is important to empirically explore further, the assumption that monetary policy and macroprudential policy are complementary. Doing so will enlighten policymakers about the extent to which monetary policy instruments can complement macroprudential policy tools to achieve financial stability. The effort of this research is therefore to reduce the uncertainty surrounding the links between the two policies, by exploring the macroeconomic effects of their interactions.

3.2 Conceptual Framework

In order to distinguish between monetary and macroprudential policies, it is important to consider the objectives and instruments of the respective policies. Monetary policy aims to achieve price stability, which focuses on stabilising inflation around its target. The policy interest rate is the commonly used monetary policy instrument. However, during a financial crisis, the policy instruments may extend to include large scale asset purchases, from the unconventional monetary policy toolkit. Monetary policy can be used to reduce (increase) the rate of money growth in the economy by increasing (reducing) the policy interest rate. This action by the central bank therefore keeps the inflation rate in check and within the target range ([Friedman, 1968](#)). On the other hand, the objective of macroprudential policy is financial stability. Its main aim is for the financial system to remain resilient and continue performing its lending function even during periods of financial distress. Sufficient resilience in the financial sector is the anchor to financial stability and reduces the probability of failure by banks to fulfill their mandate amid a financial crisis

(Dunstan, 2014). Macroprudential policy achieves its mandate of financial crisis prevention by focusing on the supervision and regulation of the financial sector. The policy authorities ensure that financial institutions accumulate capital buffers during an economic boom¹², so that they can fulfill their functions without interruption even during an economic recession, when there is a decline in economic activity. The instruments used to achieve the financial stability objective can be broadly categorised into capital and liquidity requirements (He et al., 2016). Liquidity requirements call for banks to hold enough liquid assets to meet the short-term funding demands, while capital requirements are the buffers that banks are required to hold in order to guard against unexpected losses and remain solvent (Vo, 2021).

In most cases, the monetary policy authority is the central bank, however, for macroprudential policy, the institutional arrangement varies across different countries. In some cases, the central bank implements macroprudential policy and in other instances, an independent organisation is appointed to supervise and regulate the financial sector (Nier et al., 2011). Accordingly, there are three types of arrangements that broadly define the set-up of the macroprudential framework in various economies. The first setup is whereby the central bank is given the full authority to oversee both monetary and macroprudential policies. The main advantage of this setup is that, the central bank will have regard for the spillover effects that may occur from monetary policy to financial stability (Kendall and Ng, 2013). In the second scenario, an independent committee within the central is set-up to oversee the implementation of macroprudential policy. The committee mainly comprises of representatives outside the central bank. The third and last set-up, is where decisions regarding the implementation of the prudential regulation and supervision framework is given to an independent institution outside the central bank. Proponents of the third model argue that allocating multiple functions and objectives to the central bank may jeopardise the efficiency and credibility of the central bank (Nier et al., 2011). Even though the two policies have different objectives and instruments, it is important for policymakers to coordinate them efficiently, in order to achieve the optimal policy mix for stabilising the economy. Coordination is particularly important because the two policies are interconnected, as they are both transmitted through the financial system. For instance, macroprudential policy affects lending by banks, household borrowing and consequently house prices, through the loan-to-value ratio. The transmission of macroprudential policy may therefore indirectly affect the level of inflation. Similarly, changes in the monetary policy interest rate, affects prices and output, but may also indirectly affect financial stability. Given the possibility of trade-offs between the two policies, it is therefore important for policymakers to implement them in a coordinated manner (Svensson, 2018).

3.3 Empirical Literature

A considerable amount of the literature that has been published about the effects of macroprudential policy on the real economy, does not give a conclusive response. This is in part because, the literature related to the simultaneous use of macroprudential and monetary policies is limited. Even though some economies have used the two policies in conjunction, very few of them have implemented the policies with clearly defined objectives. Experiences from emerging economies such as: Brazil, Korea and Turkey illustrate these challenges and suggest that a well-targeted macroprudential policy can complement monetary policy to achieve price stability. For instance, Brazil used monetary and macroprudential policy instruments such as, capital requirements, post the crisis period to contain excess credit growth. On the other hand, in Korea, during the 2000s, the house price swings were weakly correlated with inflation, hence, the financial regulators used the debt-to-income (DTI) and loan-to-value (LTV) ratios to address the risks in the financial

¹²An economic boom refers to periods of strong economic performance, usually characterised by increased investment and output growth.

sector, while the central bank used the policy interest rate to achieve price and output stability. Due to the fact that experience is still to be gained in most countries, policymakers may therefore misjudge the effect of macroprudential policy on the monetary policy objectives, which may give rise to policy errors (Bruno and Shin, 2013). It is therefore imperative to add to the literature that examines the interaction between the two policies and their joint effect on the policy target variables, in order to enable policymakers to make accurate and informed decisions.

Despite the difference in the objectives of the two policies, there are however notable interactions between the policies that have to be taken into consideration by central banks in their policy frameworks. For instance, Matheron and Antipa (2014) highlight that the transmission mechanisms of the macroprudential and monetary policies may overlap in some instances as they both primarily work through the financial sector. They therefore emphasise that policymakers have to look into the effects of one policy on the other when formulating and implementing the policy frameworks. The empirical analysis of the interactions between the two policies is therefore of paramount importance as they can either weaken or strengthen the effectiveness of the overall macroeconomic policy (Blanchard et al., 2014).

Smets (2014) broadly summarises the interaction between the macroprudential and monetary policies using three views. The author sets out the different ways in which the two policies can interact and the extent to which monetary policy can achieve financial stability. One well-known pre-crisis view is called the "modified Jackson Hole consensus". It emphasises that each policy should focus on its own instruments to achieve its objectives. That is, macroprudential authorities should only account for financial stability issues and monetary policy should focus on price stability.

The second view is known as "leaning against the wind". It goes against the first view by acknowledging that the two policies are interconnected. That is, in order to modify the financial cycle and its interaction with the business cycle, the policies should be implemented simultaneously. It therefore advocates for monetary policy to encompass the price and financial stability objectives (Smets, 2014).

The third view is similar to the narrative of "leaning against the wind" and emphasises that "financial stability is price stability". The proponents of this view argue that the two policies are interconnected and cannot be differentiated. It supports the notion that the interaction between the two policies is crucial and macroprudential policy should therefore take into consideration price stability issues, in order to avoid malfunction in the economy and ease the transmission process of monetary policy (Smets, 2014).

There are several studies in the literature that build on these views. Most of them use the dynamic stochastic general equilibrium (DSGE) model to investigate the optimal mix of monetary and macroprudential policies. Such studies include Beau et al. (2012), Quint and Rabanal (2014) and Angelini et al. (2012). Beau et al. (2012) estimated a DSGE model for European countries, to identify the circumstances under which macroprudential policy may have negative effects on price stability. The authors conclude that, macroprudential policy may have a limited effect on price stability in most circumstances. On the contrary, Quint and Rabanal (2014) suggest that the introduction of macroprudential policy instruments in a currency union can help to reduce macroeconomic volatility. They argue that in a currency union, macroprudential policy can be a substitute for monetary policy because the implementation of prudential tools can help to reduce accelerator effects, as a smaller response in the nominal interest rate is required. In addition, Angelini et al. (2012) use a DSGE model with a banking sector, for European economies, to assess the interaction between the two policies. They conclude that, during normal times, when the economic cycle is driven by supply shocks, the benefits of macroprudential policy instruments on macroeconomic stability

is modest. They however find that the benefits of macroprudential policy are increased when there are financial shocks in the economy and therefore recommend operating the two policies as complements in this case.

However, the existing literature remains narrow in focus and only a few studies expand it by empirically investigating the interaction between the macroprudential and monetary policies. In addition to the literature on the DSGE model, very few studies analyse the dynamics between the two policies in a setting of the vector autoregression (VAR) framework. For instance, [Kim and Mehrotra \(2017\)](#) use the panel VAR methodology to explore the effects of the two policies in the Asia-Pacific region. Using a dataset by [Shim et al. \(2013\)](#), the authors advocate for the coordination of the two policies as they argue that the policies have similar effects on the financial sector and the real economy. Their analysis finds that, the simultaneous tightening of both monetary and macroprudential policies reduces credit, inflation and output. However, [Zdzienicka et al. \(2015\)](#) adopt a different perspective and argue that the two policies differ in terms of their effects on the economy. They examine the interaction of the two policies using data on macroprudential measures and exogenous monetary policy shocks for the United States. Contrary to other studies, the authors conclude that tightening monetary policy can result in a persistent and negative impact on property prices and bank credit, which weakens long-term financial stability. In addition, they find that although the effect from macroprudential measures on financial conditions is immediate, it only lasts for a shorter period of time. In addition, the findings from two more studies by [Gambacorta and Pabón \(2017\)](#) and [Chadwick \(2018\)](#) on five Latin American countries and Turkey, respectively, recommend macroprudential policy to be more effective in curbing credit growth, inflation and output volatility, especially when used in conjunction with monetary policy.

3.3.1 The "lean versus clean" Debate

During the pre-crisis period, there was very little consideration about the role of excessive credit growth on financial instability. In addition, most policymakers supported the Jackson Hole consensus view that monetary policy should disregard the fluctuations in asset prices and focus on cleaning up after the asset price bubble, in order to restore macroeconomic stability ([Raputsoane, 2015](#)). The literature by [Bernanke \(2009\)](#) and [Svensson \(2012\)](#) was in support of this view, highlighting the difficulty involved in identifying asset price bubbles. They therefore contend that it is impossible for monetary policy instruments to address asset price bubbles without detrimental consequences to the price stability objective ([Raputsoane, 2015](#)).

However, post the 2007-2008 global financial crisis, there have been questions about whether policymakers could have intensified their response to prevent the contagion effect of imbalances in the financial sector ([Kockerols and Kok, 2019](#)). The focus was particularly on asset price bubbles caused by excessive credit growth and how to contain them, as they were found to cause price misalignments that exacerbate systemic risk and ultimately financial instability ([Brunnermeier et al. \(2012\)](#) and [Jordà et al. \(2015\)](#)). This gave rise to the "lean versus clean" policy debate among policymakers and academics. The debate is centred around whether monetary policy should be tightened over and above what is required to achieve price and output stability¹³ in order to prevent financial crises, or implement an overly accommodative monetary policy to stabilise the economy after a financial crises occurs. The leaning against the wind view underscores the costs associated with the bailout arrangement following a financial crisis.

¹³[Mishkin \(2011\)](#) documents that the concept of leaning against the wind of credit and asset prices bubbles refers to raising the monetary policy interest rate to a level above one that is required to achieve price and output stability. This is done to achieve financial stability as an additional objective in the monetary policy framework.

The clean policy however, emphasises that economic booms are not always a result of negative economic fundamentals but may be a consequence of an improving economy, and should therefore not be inhibited by policy interventions (Katagiri et al., 2012).

Gali and Gambetti (2015) argue that post the crisis, the concept of the Jackson Hole consensus, which emphasises that monetary policy should ignore asset price developments, is no longer valid. They assert that, monetary authorities should "lean against the wind" and that the monetary policy framework should therefore take into consideration the asset price developments and react to financial imbalances before they occur. Taylor (2014), Mishkin (2011) and Woodford (2012) also support this view. On this note, the general agreement is that, leaning against the wind is more practical since it is difficult to accurately predict the formation of asset price bubbles. Furthermore, inflation and output stability do not reflect financial stability, because a financial crisis can occur in the midst of perceived stable monetary policy conditions (Raputsoane, 2015). The empirical evidence by Trichet (2009) and Woodford (2012) further suggest that monetary policy can effectively lean against the wind if the relationship between the policy interest rate and the asset price misalignments is symmetric. This implies that central banks raise the policy interest rate beforehand to prevent financial imbalances and adopt an overly accommodative monetary policy after a financial crisis so as to reduce the negative economic effects. Trichet (2009) points out that when central banks "lean against the wind", it reduces risk taking behaviour in the financial sector during an economic boom and encourages investment after an economic downturn.

However, some studies contradict this viewpoint and propose that monetary policy should be used to "clean up after the asset price bubble has burst". Findings to support the "clean up after the bubble has burst" policy can be traced back to the pre-crisis period where studies by Borio and Lowe (2004), Bernanke (2009) and Yellen (2009) defend this principle. The authors remark that following a financial crisis, an overly accommodative monetary policy can be used to contain the effects of the asset price bubble. This view suggests an asymmetric relationship between the asset price misalignments and the monetary policy interest rate. The asymmetric relationship stems from the fact that central banks ignore the asset price developments during an economic boom and only react to the misalignments during an economic downturn.

Furthermore, Svensson (2017) argues that the costs of leaning against the wind of credit and asset price bubbles exceeds the benefits. This is because even though monetary policy tightening keeps inflation rates low, it can however result in high unemployment in the event that there is no financial crisis. In addition, Kockerols and Kok (2019) point out that, some central banks that adopted the leaning against the wind policy post the crisis, have not achieved much success and have experienced low inflation and high unemployment rates which compromised financial stability by increasing the burden of debt on households. Some researchers have however criticised this view for its failure to account for the persistence of the financial cycle. The critiques highlight that accounting for the long-lasting effects of a financial crisis would create a case to further tighten monetary policy to address financial instability.

Over the years, the ongoing debate has evolved into two opposing views. The first view calls for monetary and macroprudential policies to function as independent policies with separate objectives (Bean et al., 2010), while the second supports the full merging of the two policies (Sannikov and Brunnermeier, 2012). In light of this, Angelini et al. (2012) and Smets (2014) call for the inclusion of the macroprudential policy objective in the monetary policy framework. Smets (2014) however highlights that doing so requires a thorough understanding of the extent at which monetary policy can remain independent amid its ability to accommodate the financial stability objective, in order to ensure that the optimal reaction function of the monetary policy authorities is unaffected. The author highlights that, this is important in order to prevent

financial dominance, where monetary policy is diverted from its primary objective and becomes overly concerned with the financial stability objective. On the contrary, some researchers oppose the inclusion of the financial stability objective in the monetary policy framework and consider macroprudential policy instruments to be more effective tools in achieving the financial stability objective because it can directly target financial sector imbalances.

Although it is evident that in most cases, a financial crisis is preceded by the excessive growth of credit and asset prices, the debate on whether monetary policy has the capacity to achieve the financial stability objective and what the consequences of doing so would be, has not been resolved. It has however been the foundation for the modern day discussions about the consequences of each policy on the other and hence the degree of coordination between monetary and macroprudential policies.

4 Data and Estimation Technique

4.1 Data

To measure the macroeconomic effects of the monetary and macroprudential policy shocks, I use a panel dataset which consists of quarterly data spanning the period 1990Q1 to 2016Q4 for five major emerging economies. The empirical estimation technique used in this study includes two policy instruments: the macroprudential policy index (mpi) as the macroprudential policy instrument and the policy interest rate (r) as the monetary policy instrument. In line with theoretical models in the literature, the study also considers two target variables for each policy. For example, in the model by [Christiano et al. \(1999\)](#), the central bank sets the policy interest rate after observing the current values of inflation and output, while the model by [Quint and Rabanal \(2014\)](#) indicates that the macroprudential policy instruments respond to the financial conditions such as house prices and credit. In this case, the real GDP (rgdp) and the consumer price index (cpi) are the target variables for monetary policy, while, total credit-to-GDP (tcr_to_gdp) and house prices are the policy target variables for the financial stability objective. The data used is obtained from the Bank for International Settlements (BIS) databank, the Organisation for Economic Co-operation and Development (OECD) databank and the integrated macroprudential policy (iMaPP) database developed by [Alam et al. \(2019\)](#).

The countries considered are Brazil, Russia, India, China and South Africa (BRICS). [Claessens et al. \(2013\)](#) argues that, emerging markets (EMs) tend to have more exposure to financial shocks and thus face greater challenges in terms of managing the procyclicality of the financial and business cycles. The shocks in the EMs are also frequent and relatively large compared to the size of the financial sectors. This is largely because the banking sector tends to dominate the financial sector in most EMs. In addition, EMs have larger financial flows and greater foreign bank presence compared to advanced countries (ACs). Unsurprisingly, therefore, shocks tend to be more amplified in EMs ([Canuto and Ghosh, 2013](#)).

Despite the progress made by EMs, most of them still lag behind ACs in their measures of overall quality of institutions and the enforcement of financial regulations. In addition, the level of transparency and information disclosure in EMs tends to be lower than in ACs. These factors tend to amplify the transmission of financial shocks in EMs. [Claessens et al. \(2013\)](#) explored the links between the various financial cycles in EMs and compared them with those in ACs. They conclude that, indeed, the interaction between financial and business cycles in EMs tends to be greater compared to in ACs. All these issues, therefore underscore

the importance of research that contributes to the literature, by exploring policy coordination options that can help to enhance the resilience of the financial systems in EMs.

4.2 Variable Selection

Macroprudential policy index (mpi): In the spirit of [Kim and Mehrotra \(2017\)](#), I construct an index as a measure of macroprudential policy, using 17 policy instruments. A simple sum of the scores of the tightening policy actions from the integrated macroprudential policy (iMaPP) database is created.

The iMaPP database was released in March 2019 and consists of 17 demand-side and supply-side macroprudential policy measures. It consolidates data from five major existing databases. These are the Global Macroprudential Policy Instrument (GMPI)¹⁴, [International Monetary Fund \(2011\)](#), [Lim et al. \(2013\)](#), [Shim et al. \(2013\)](#), the Annual Macroprudential Survey by the International Monetary Fund, coupled with information from the Financial Stability Board (FSB), the Bank for International Settlements (BIS) and national sources. I include the macroprudential policy actions as an index variable and the changes in the policy actions are accumulated over time. This implies that, when macroprudential policy is eased (tightened), the level of the index decreases (increases) by one unit. The index will change to a new level only if another macroprudential policy action is taken. There are several studies in the literature that have modelled macroprudential policy as an index ([Akinci and Olmstead-Rumsey \(2018\)](#); [Bruno et al. \(2017\)](#); [Cerutti et al. \(2016\)](#); [Kim and Mehrotra \(2017\)](#)). The expectation is that, when countries frequently use macroprudential policy instruments, their output growth is less volatile.

Total credit-to-GDP (tcr_to_gdp): This is the metric comparing the domestic total financial resources given to the private sector by the financial sector, to its gross domestic product (GDP). Most of the literature finds that strong credit growth typically precedes financial crises ([Cerutti et al., 2016](#)), which justifies the focus on this variable as one of the target variables for macroprudential policy ([Kaminsky and Reinhart \(1996\)](#); [Schularick and Taylor \(2012\)](#); [Jordà et al. \(2011\)](#)). It is in this light that, credit-to-GDP gaps are considered to be very useful early warning indicators for banking crises. They are considered to be useful in identifying vulnerabilities within the banking sector, which can greatly help to guide regulators to deploy the appropriate macroprudential policy tools ([Borio and Lowe, 2002](#)). Several studies in the literature recognise the strong link between credit booms and the financial crisis, for example; [Salas and Saurina \(2002\)](#) link excessive credit growth with loan defaults and [Jimenez et al. \(2006\)](#) conclude that there is a strong connection between credit cycles and credit risk. This is consistent with the aftermath of the 2007-2008 global financial crisis, where countries with larger credit booms leading up to the crisis, saw more sluggish recoveries compared to economies that went into the crisis with smaller credit booms ([Mian and Sufi, 2015](#)).

According to the recommendations from the third Basel Accord (Basel III)¹⁵, it is however important to make sure that the definition of credit in this context is extended to cover all the sectors in the economy. This suggests that the effectiveness of the credit-to-GDP gap as an early warning indicator can be enhanced by making sure that it accounts for all the sources of credit in the economy. Even though both credit series capture credit to the private sector and cover the same set of financial instruments, they differ in terms of the coverage of lenders. The total credit series captures, as much as possible, all sources of credit. It goes

¹⁴The GMPI survey contains exhaustive information on the use and timing of the various macroprudential policies ([Cerutti et al., 2016](#)).

¹⁵Basel III (Third Basel Accord) is a set of regulatory guidelines developed by the Basel Committee following the 2007-2008 financial crisis, for the Banking Supervision framework. Their main aim is to strengthen the supervision, regulation and risk management of the financial sector ([Kapoor and Kaur, 2017](#)).

beyond credit provision by the domestic depository corporations such as, savings banks, commercial banks and credit unions and includes all types of lending in the economy (Dembiermont et al., 2013). It is for this reason that I use total credit-to-GDP as opposed to bank credit-to-GDP.

House prices (hp): The housing prices indicator is an index of residential property prices over time. It includes the main elements of housing costs; rent prices, nominal and real house prices. In most cases, the nominal house price covers the sale of existing and newly-built dwellings. Rising house prices can attract speculators hoping to earn profit in some instances. As the speculators enter the property market in large numbers, the probability of an asset price bubble also increases. When the bubble bursts, the effect can be catastrophic, spreading shock waves across the economy. It is therefore important for policymakers to stabilise the growth of house prices. The house prices in this case are used as a proxy for asset prices and one of the target variables for macroprudential policy (Svensson, 2012).

Policy interest rate (r): This is the interest rate at which a country's monetary authority lends money to banks, mostly in the form of short-term loans. The monetary authority which in most cases is the central bank, uses this method to influence economic activities. Expansionary monetary policy is when the monetary authority cuts the interest rate in order to stimulate borrowing. Conversely, an increase in the policy interest rate is referred to as contractionary monetary policy, which raises the cost of credit and consequently reduces borrowing in the economy. When contractionary monetary policy is implemented, monetary policy can affect the real economy by reducing aggregate demand, hence putting downward pressure on prices and ultimately affecting output and inflation, while higher bank rates rein in the economy when the inflation rate is high (Svensson, 2012).

Consumer price index (cpi): The CPI is an index that is used as a representative of the prices of goods and services in an economy. More specifically, it is an index with weights that reflect the shares of the different categories and sub-categories of goods and services in the total expenditures. The annual percentage change in the CPI is used as a measure of inflation (Kim and Mehrotra, 2017). The inclusion of prices is justified because the borrowing decisions of economic agents reflect the changes in the policy interest rate through the shift in prices (Carboni et al., 2013). Even though the economic literature documents that the personal consumption expenditure price index (PCE)¹⁶ is a superior measure of inflation compared to the CPI, the expenditure data that is required to construct the PCE price index is not available in most countries. This study therefore uses the CPI as a measure of inflation because the data is readily available.

Real GDP (rgdp): The real GDP represents the value of goods and services that are produced in an economy, in a given year. The variable is used as a proxy for output (Nielsen, 2019). The inclusion of output in the estimation reflects the stabilisation of the real economy from the indirect effects following the disruptions in the financial sector (Gelain and Ilbas, 2017). Furthermore, Carboni et al. (2013) suggests that, macroprudential policy instruments that target loans to non-financial corporations have pronounced multipliers on output and prices. It is therefore imperative to include the two variables as the literature suggests that the macroprudential policy shocks may significantly affect them.

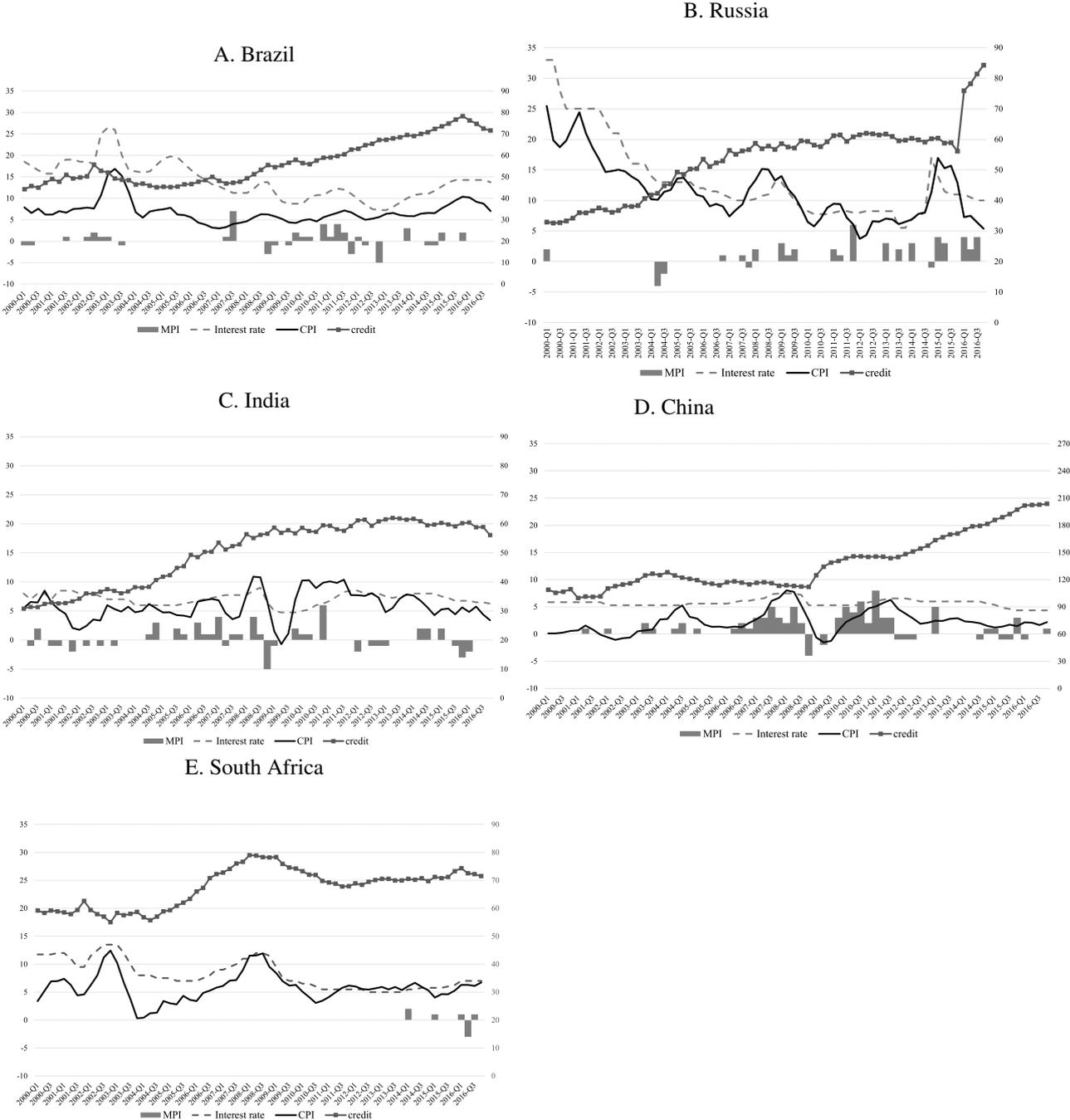
4.3 Descriptive Evidence

Figure 2 presents the policy trends in the BRICS economies. Overall, it is evident that the BRICS economies operate a countercyclical monetary policy. This implies that, monetary policy authorities

¹⁶Compared to the CPI which only measures the expenditure on goods and services by households, the PCE also includes spending by institutions that serve households on items that do not have market prices, such as free medical care (Hakkio, 2008).

increase the policy interest rate by implementing contractionary monetary policy in order to ease inflationary pressures and implement expansionary monetary policy during economic recessions, to stimulate economic growth, such as during the 2007-2008 global financial crisis.

FIGURE 2: Policy trends in BRICS economies, 2000Q1 - 2016Q4



Notes.- The graphs show the trajectory of the policy tightening/easing alongside the inflation and credit series.

China has a relatively stable inflation rate, compared to the other BRICS economies. Most emerging economies were vulnerable to the financial crisis because they maintained their high growth rates by exporting to advanced economies. Figure 2 however shows that India experienced a sharp decline in its economic growth during the period of the global financial crisis. This is mainly because large components of the growth rates in India were due to the export sector. Most of the demand for the country’s exports was therefore badly affected by the crisis. The exports in India grew by an average of 22 percent annually prior to the crisis compared to 14.2 percent in 2007-2008. In addition, it was difficult for Indian businesses to

continue borrowing in the external markets due to the tightening credit conditions in advanced economies. Despite the contagion effect of the financial crisis on the country, India was one of the few countries that recovered quickly. This was mostly due to the interventions in the foreign exchange market by the government (Viswanathan, 2010).

The implementation of macroprudential policy instruments in the BRICS economies, differs across countries. Figure 2 also shows that China and India frequently implement macroprudential measures to curb excess credit growth, while South Africa has the least experience with the use of macroprudential policy instruments. In addition, Russia and South Africa appear to have increased their use of macroprudential policy measures after the 2007-2008 global financial crisis, mostly tightening the macroprudential policy measures in response to the upward trend in credit growth. On the part of South Africa, Hollander and van Lill (2019) suggest that, the country has been restrained in the use of macroprudential tools due to its approach of subordinating macroprudential policy in favour of preventive measures such as, an accountable banking supervision framework.

Overall, the descriptive evidence mostly shows positive co-movement between the monetary policy interest rate and the macroprudential policy index. That is, monetary policy tightening (increase in policy rate) coincides with tighter macroprudential policy. This therefore indicates that, the two policies are used in a complementary way, which reduces the likelihood of an opposing effect (Kim and Mehrotra, 2019).

4.4 Estimation Technique

To analyse the effects of the policy shocks¹⁷ in the BRICS economies, I estimate a panel VAR model using the two-step system GMM technique. I adopt the estimation technique in order to overcome the problem of biased estimates and potential endogeneity commonly found in panel data estimations¹⁸.

The specification of the panel VAR estimation follows Love and Zicchino (2006). It is in a reduced form, whereby the independent variables in each equation, are the lagged values of the endogenous variables. Assuming subscript i to be the country index and t as the period index, I estimate the following reduced form panel VAR with fixed effects:

$$Y_{i,t} = A_0 + A(L)Y_{i,t-l} + c_i + d_t + \varepsilon_{i,t} \quad (1)$$

The equation captures the policy domain, the financial system and the real economy, where the vector of endogenous variables, $Y_{i,t}$ is defined as: $[\text{rgdp}_{i,t}, \text{cpi}_{i,t}, \text{tcr_to_gdp}_{i,t}, \text{house prices}_{i,t}, \text{mpi}_{i,t}, \text{r}_{i,t}]'$. A_0 is the vector of constants and $A(L)$ is the lag operator of the endogenous variables. While c_i measures the country fixed effects and d_t is the fixed time effect to control for any time factors that are unobservable across countries. Finally, $\varepsilon_{i,t}$ is the error term and varies across countries i and time periods t .

The main advantage of the VAR system is that it allows one to use the impulse response functions¹⁹ to estimate the effect of a shock in the policy variables (macroprudential policy index and policy interest

¹⁷The policy shocks represent the deviation of the policy rate and the macroprudential policy index from that prescribed by the policy rule in the model.

¹⁸I difference all the variables prior to inclusion in the model. Differencing removes the series dependence on time and therefore eliminates or reduces trend and seasonality.

¹⁹The impulse response functions describe the evolution of a model's variables in reaction to a shock in one or more variables, while holding all other shocks equal to zero. They are useful tools when analysing interactions between variables in a VAR system ((Nielsen, 2019) and (Lanne and Lütkepohl, 2008)).

rate), on the macroeconomic and financial variables. Although the VAR also allows for the inclusion of country fixed effects (c_i) in the model, the detriment of including fixed effects in the panel VAR estimation is that it may be correlated with the lagged dependent variables and the error term. In order to address this issue, I estimate the panel VAR model using the two-step system GMM technique by [Blundell and Bond \(1998\)](#). The two-step system GMM overcomes possible autocorrelation and endogeneity by instrumenting the lagged dependent variables, which yields consistent and efficient estimates ([Nickell \(1981\)](#); [Roodman \(2009\)](#))).

The first step of the two-step system GMM estimation procedure is therefore to eliminate country-specific effects through a first difference transformation proposed by [Arellano and Bond \(1991\)](#) and [Holtz-Eakin et al. \(1988\)](#):

$$Y_{i,t} - Y_{i,t-1} = A_0 + A(L)(Y_{i,t-1} - Y_{i,t-2}) + (d_t - d_{t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (2)$$

It is however not recommended to use the first difference estimator specified in equation (2) as it can produce biased results, because in most cases $(Y_{i,t-1} - Y_{i,t-2})$ is likely to be correlated with the error term $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$. [Blundell and Bond \(1998\)](#) therefore developed the second step to the system GMM estimator which is a combination of the equation in levels (equation (1)) and in first difference (equation (2)). In addition, they impose the restriction specified in (3), which ensures that the lagged dependent variables are exogenous to the country fixed effects and the error term, (for $t = 3, \dots, T$):

$$E[\Delta Y_{i,t-1}(c_i + \varepsilon_{i,t})] = 0 \quad (3)$$

In contrast to the first differencing technique by [Arellano and Bond \(1991\)](#), the two-step system GMM by [Blundell and Bond \(1998\)](#) uses forward mean-differencing, also known as the Helmert procedure. The Helmert procedure only removes the forward mean, that is, the mean of all the future observations. It therefore allows one to use the lagged dependent variables as instruments and estimate the coefficients by system GMM. The two-step system GMM estimation method therefore gives consistent and efficient estimates and several researchers such as [Soto \(2009\)](#) and [Abrigo and Love \(2016\)](#) support the use of the two-step system GMM estimator and confirm that it yields results with the lowest bias.

5 Empirical Results

This section reports the findings from the two-step system GMM. I use the policy interest rate (r) and the macroprudential policy index (mpi) as proxies for monetary policy and macroprudential policy, respectively. I first examine the causal relationship between the target variables and the policy variables. I then use the impulse response functions (IRFs) to analyse the reaction of the target variables to the contractionary macroprudential and monetary policy shocks²⁰. Thereafter, I assess the variance decomposition in order to estimate how much of the variation in the response variables is attributed to the policy shocks.

²⁰The shocks are implemented through a 'surprise' increase in the policy interest rate and the macroprudential policy index.

5.1 System GMM Causality Results

Table 1 highlights the causal relationship between the policy variables and the target variables. The first row indicates that a 1 percent increase in the macroprudential policy index will result in an increase in output by approximately 0.07 percent. However, the increase in the macroprudential policy index causes a decrease of 0.17 percent and 0.09 percent in total credit and house prices. The results indicate that in addition to achieving the financial stability objective, macroprudential policy has spillover effects on the real sector through output.

The second row shows that a 1 percent increase in the policy interest rate causes a decrease in the growth of output, total credit and house prices by 0.11 percent, 0.36 percent and 0.45 percent, respectively. The negative relationship between the policy interest rate and the financial variables implies that the implementation of monetary policy in the BRICS economies, has spillover effects on the financial sector. However, the increase in the policy interest rate also results in a price puzzle, which indicates that monetary policy achieves the financial stability objective at a cost of price instability.

TABLE 1: Estimated granger causality for the dynamic panel system GMM (Baseline model)

	Dependent Variables (response variables)			
	drgdp	dcpi	dcr_to_gdp	dhouseprices
$dmpi_{t-1}$	0.0733*** (0.022)	0.0033 (0.024)	-0.1681*** (0.040)	-0.0886* (0.043)
dr_{t-1}	-0.1088** (0.039)	0.2275** (0.077)	-0.3609*** (0.076)	-0.4520*** (0.094)

Notes.- The table shows the causal relationship between the policy variables and the macroeconomic and financial variables, in the baseline model. ***, ** and * indicate the statistical significance at 1 percent, 5 percent and 10 percent levels respectively. The standard errors are in parenthesis.

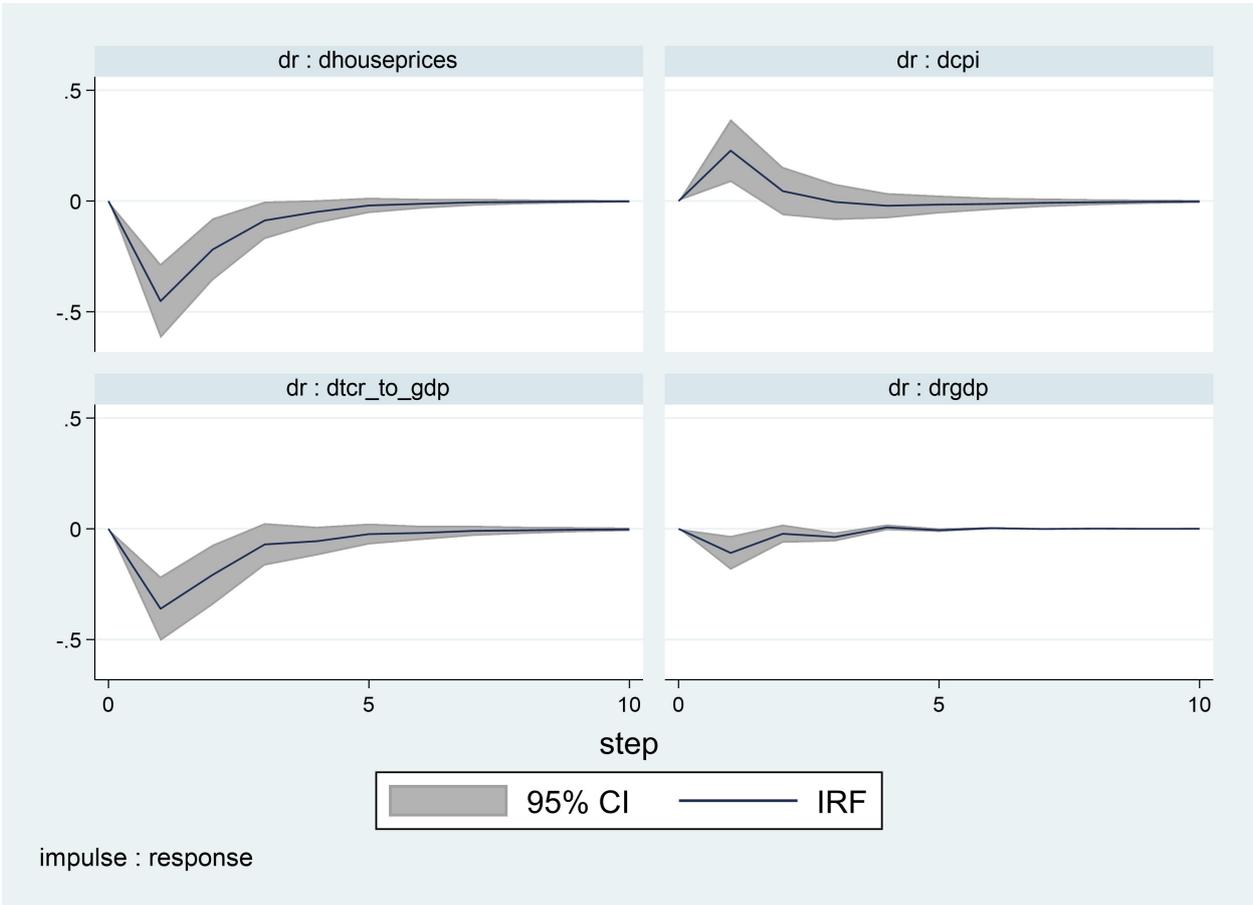
5.2 Impulse Response Analysis

5.2.1 Output

Figure 2 shows that a contractionary monetary policy shock results in a decrease in output. In the short-run, the surprise increase of 100 basis points in the policy interest rate reduces quarterly output growth by about 0.1 percent during the first period. This follows the economic theory that, monetary policy affects business expansion and aggregate demand through money supply (Nielsen, 2019). However, the effect does not seem to apply in the long-run as real GDP growth oscillates around zero. This is also in line with economic theory because monetary policy has short-to-medium term effects. On the other hand, figure 3 indicates that a macroprudential policy shock increases output growth by 0.1 percent during the first period. The effect however fades in the long-run. Even though there is no consensus in the literature about the effect of macroprudential policy on the real economy, a study by Behn et al. (2016) suggests that, when additional capital requirements are achieved by investing capital, then GDP growth responds positively. The authors further state that, the implementation of macroprudential policy measures that result in an increase in the lending rate will consequently push down the aggregate demand and output. In addition, Boar et al.

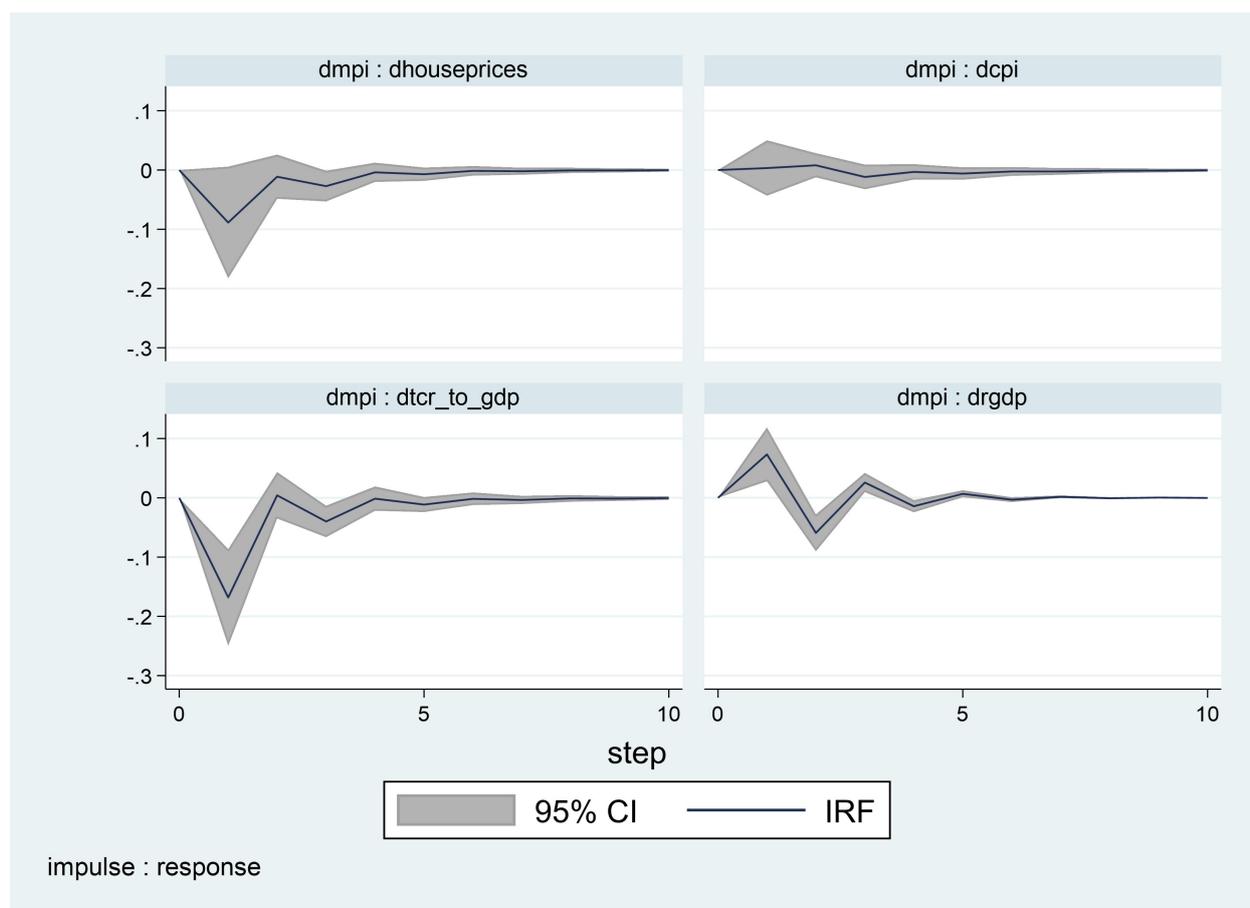
(2017) also suggests that, macroprudential policy is a less effective tool for sustaining economic growth in the long-run. This confirms the notion that macroprudential policy is more suited to achieve the financial stability objective.

FIGURE 3: Impulse responses to monetary policy shock (Baseline model)



Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a monetary policy shock. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE 4: Impulse responses to macroprudential policy shock (Baseline model)



Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a macroprudential policy shock. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

5.2.2 Inflation

Contrary to the expected results, a monetary policy shock results in a statistically significant increase in the inflation rate, suggesting the existence of a price puzzle (Table 1 and figure 3). The empirical results reveal that a monetary policy shock is positively correlated with inflation. This suggests that even though a positive shock in monetary policy achieves the financial stability objective, it however fails to attain its primary objective of price stability.

Findings by Sims (1992) further suggest that the price puzzle can also occur when inflation is largely driven by supply shocks. In such a case, the supply side effects dominate the demand side effects. This supports the findings in the literature, as most emerging economies are dependent on commodity exports and are therefore prone to supply shocks. Furthermore, evidence from a study by Kutu and Ngalawa (2016), which examines the effect of monetary policy shocks in the BRICS economies suggests that, most of the variations in inflation are due to the shocks from the exchange rate. They conclude that, if the central bank devalues the domestic currency in order to stimulate the economy, the policy action may have inflationary effects²¹. In the past years, most emerging economies transitioned from the fixed exchange rate arrangement to the flexible exchange rate system. It is therefore possible that the increase in the inflation rate was due to the effects of the exchange rate. This is important because large variations in the exchange rate can

²¹I investigate this argument by assessing the effect of an exchange rate shock on the macroeconomic and financial variables, in section 9.3.

destabilise prices. More specifically, a large depreciation and economic downturn are often followed by an increase in the inflation rate, despite a slowdown in economic activity. The authors however emphasise that the impact is short-term, hence, inflation decreases in the long-run, when the effect of the monetary policy shock sets in. [Balke and Emery \(1994\)](#) also suggest that, the effect of the price puzzle fades away in the long-run, due to the central banks placing more emphasis on the price stability objective or due to fewer supply shocks in the economies over time. The results in this paper however contradict the findings by [Kim and Mehrotra \(2017\)](#), who examined the effects of the policies in four Asia-Pacific countries. According to the authors, a majority of the macroprudential policy instruments significantly affect aggregate demand and have a contractionary effect on the price levels.

5.2.3 Total credit-to-GDP

Even though both monetary and macroprudential policy shocks effectively limit credit growth, the decrease in total credit is more responsive to a monetary policy shock (figure 3 and figure 4). Overall, it is evident that a surprise increase of 100 basis points in the policy interest rate increases the cost of borrowing and inhibits credit growth. This indicates that in the short-run, monetary policy can be used to complement the effectiveness of macroprudential policy, to reduce the excessive growth of credit. The results are similar to the findings from the existing literature on advanced economies, by [Cerutti et al. \(2016\)](#) and [Zdzienicka et al. \(2015\)](#). It is therefore important for policymakers to consider this side effect of the policy interest rate when crafting the macroeconomic policy.

5.2.4 House prices

The impulse response functions in figure 3 and figure 4 suggest that both the macroprudential and monetary policy shocks have a negative effect on the growth of house prices in the short-run. This suggests that, for the case of the BRICS economies, monetary policy can play a supportive role in achieving the financial stability objective. However, the impulse response functions indicate that in the long-run, monetary policy should not be the first in the line of defense against financial stability issues that stem from excessive growth in house prices. Figure 3 however shows that house prices increase slightly over time following a macroprudential policy shock. This could indicate speculative demand by property investors. The speculative demand occurs when there is a rise in the demand for houses due to the expectation of another macroprudential policy shock in the future, which results in a rise in house prices in the short-run. The results are similar to related work by [Nielsen \(2019\)](#) for 11 OECD countries.

5.3 Policy Implications

The policy implication of the results is that policymakers should be cautious when deploying monetary policy for financial stability purposes because the policy interest rate required to achieve financial stability is inconsistent with that required for the price stability objective ([Liu and Molise, 2020](#)). For instance, a further increase in the policy interest rate required to eliminate the price puzzle would further decrease the growth of credit and house prices and possibly drive down the economic activity ([Svensson, 2017](#)). The results imply that there is a trade-off between the price stability and financial stability objectives. This paper therefore recommends that monetary policy should not be used as a substitute for macroprudential policy but as a complement to enforce the financial stability objective. The policy design in the BRICS

economies should therefore ensure that each policy focuses on its primary objective²² while taking into consideration the spillover effects from the other policy. This follows the principle of economic policy which states that economic policies should only target policies that they can efficiently achieve. The empirical findings in this study therefore do not support the notion that monetary policy should "lean against the wind" of asset price and credit bubbles because it may result in a policy conflict, where the effectiveness of monetary policy to achieve price stability is compromised. Svensson (2018) contributes to the "leaning against the wind" debate by emphasizing that even countries that have weak macroprudential policies should not substitute it with monetary policy. The author highlights that, in any case, the costs of "leaning against the wind" outweigh the benefits, in terms of unemployment and output, especially when implemented without any supporting analysis. Svensson (2018) attempts to bring the debate to a close by suggesting that policy authorities can either implement the two policies separately or in a coordinated way. Implementing monetary policy and macroprudential policy separately means that they are conducted in a game-theoretic Nash equilibrium whereby each policy focuses on its main objective and the policies are not implemented simultaneously. Alternatively, authorities can coordinate the policies to resemble a game-theoretic coordinated equilibrium. In this case, the two policies are implemented simultaneously with the aim of achieving both financial stability and price stability albeit with separate policy instruments. Separating the policy instruments and objectives means that each policy is distinct and makes it easier for the policy authorities to evaluate their effectiveness.

It is on this note that Hollander and van Lill (2019) argue that for the case of South Africa, the central bank is cautious and has only implemented a handful of the macroprudential policy instruments. The main reason being that the implementation of a varying number of macroprudential policy instruments may generate conflicting effects with other policies such as monetary policy. The authors further highlight that in most cases, macroprudential policy should play a supportive role to monetary policy. On the contrary, a study by Zhang et al. (2020) highlights that China attaches more emphasis on the use of macroprudential policy instruments to eliminate financial imbalances. This is evident in figure 2. This is primarily because compared to other emerging economies, China has a more extensive trading system and therefore any imbalances in its financial sector could have a more widespread impact on the rest of the world.

5.4 Forecast Error Variance Decomposition

Table 2 in this subsection complements the impulse response analysis by examining the variance decomposition. The Table reports the fraction of the forecast variance of the target variables attributable to innovations in the policy shocks, thereby indicating various degrees of importance of each policy variable in explaining the variation in the target variables at the 2-year, 5-year and 10-year horizons.

The results in Table 2 reveal that monetary policy shocks contribute to most of the variations in inflation (1.7 percent at the 10-year horizon), total credit (3.8 percent at the 10-year horizon) and house prices (2.9 percent at the 10-year horizon), while the volatility in output is significantly explained by macroprudential policy shocks (15.4 percent at the 10-year horizon). Kim and Mehrotra (2017) suggest that the effect of macroprudential policy shocks on output coincides with the influence of the policy on aggregate demand. At the 10-year horizon monetary policy shocks account for 1.7 percent of the variance in inflation, but the effect of macroprudential policy shocks on the same variable appears to be muted (0 percent). In addition, a

²²The primary objective of monetary policy should be price and output stability while macroprudential policy should aim to achieve financial stability.

TABLE 2: Forecast Error Variance Decomposition

		Horizons		
		2 years	5 years	10 years
rgdp	mpi shock	0.9	15.3	15.4
	r shock	0.6	0.7	0.7
cpi	mpi shock	0.0	0.0	0.0
	r shock	1.7	1.7	1.7
tcr_to_gdp	mpi shock	1.6	1.6	1.6
	r shock	3.0	3.8	3.8
house prices	mpi shock	0.2	0.2	0.2
	r shock	2.3	2.9	2.9

Note.- The table shows the forecast error variance decomposition of real GDP (rgdp), inflation (cpi), total credit-to-GDP (tcr_to_gdp) and house prices to macroprudential and monetary policy shocks, in percentage.

positive shock in monetary policy accounts for 3.8 percent and 2.9 percent in total credit and house prices at the 10-year horizon, compared to 1.6 percent and 0.2 percent explained by macroprudential policy shocks.

Overall, the variance decomposition suggests that a positive shock in monetary policy is closely linked to the financial sector, significantly influencing both total credit and house prices, while its impact on the real economy is only prominent in the inflation rate. This implies that monetary policy has spillover effects on the financial sector through total credit and house prices. On the other hand, an implementation of macroprudential policy achieves financial stability through total credit and house prices, but it has side effects on output. In this regard, the evidence suggests that the implementation of the two policies, has to be done in a coordinated manner, considering the possible spillover effects of each policy on the other. For example, when economic conditions are such that output growth is low while total credit and house prices are buoyant, under such circumstances, loosening monetary policy to stimulate output growth may result in imbalances in the financial sector due to excessive growth in credit and house prices. For instance, the observations for the BRICS economies indicate that during the period of study, the average economic growth was 3.4 percent while on average, house prices and total credit increased by 65.6 percent and 66.7 percent, respectively. Consequently, credit growth and house prices were indicative of financial instability while there was capacity for economic growth to expand further.

The evidence is concordant with previous studies by [Zdzienicka et al. \(2015\)](#) and [Kim and Mehrotra \(2017\)](#), who also find that a contractionary macroprudential policy shock has a significant effect on output. The authors also conclude that both monetary and macroprudential policies affect credit growth. This also validates evidence by [Cerutti et al. \(2016\)](#), who argues that the two policies significantly affect credit growth more than house prices because it is easier to moderate credit than house prices.

5.5 Extended Model

Following [Sims \(1992\)](#), I extend the baseline model by introducing commodity prices in the panel VAR, in order to resolve the price puzzle. The author suggests that the price puzzle may occur because the interest rate partially reflects the inflationary pressures, which can result in an increase in prices. The author therefore proposes that commodity prices can capture additional information about future inflation. The results however indicate that, the price puzzle is not muted after the inclusion of commodity prices

(figure B1). This suggests that there could be other factors contributing to the rise in prices after a monetary policy tightening. For instance, this may indicate that inflation is largely being driven by supply shocks. In such a case, the supply side effects may dominate the demand side effects. However, after the fourth period the price puzzle fades away, which suggests that the central banks may have become more forward looking in their price stability efforts and effectively preempted the inflationary pressures. Alternatively, the monetary policy authorities may have placed more weight on price stability when reacting to supply shocks in the long-run (Balke, 2000).

Furthermore, there exists another stream of literature which suggests that the inclusion of commodity prices alone has limited capacity to solve the price puzzle because there are additional factors that may result in a price puzzle. These include, the monetary policy regime, openness of the economy, central bank independence and inflation volatility. For example, Rusnak et al. (2013) document that in an open economy where the central bank is fully independent, monetary policy is more effective because the exchange rate channel can amplify its impact. For instance, in an open economy with a fully independent central bank, contractionary monetary policy will result in an appreciation of the real exchange rate, which makes imports cheaper and thus amplifies the decrease in the aggregate price level (Bhuiyan, 2008). For the case of the BRICS economies, it is therefore worthwhile for future studies to further explore the issue surrounding central bank independence and its effect on the price puzzle because some studies in the literature indicate that the central bank in China has not yet achieved full independence, which can affect the results. Rusnak et al. (2013) also suggest that high inflation rates can impede the central bank's credibility and interfere with its ability to control prices, hence the finding that the price level increases following a contractionary monetary policy. This may also apply to the results for the BRICS economies given that Russia experienced some episodes of hyperinflation in the 1990s which was due to the policy reform and the expansion in money supply.

6 Sub-sample Analysis

6.1 Analysis during financial crises periods

There are two major financial crises that occur during the period of study, the 1997 Asian financial crisis and the 2007-2008 global financial crisis. It is therefore important to develop a sub-sample analysis, in order to assess the effects of the policy shocks in the BRICS economies, during the financial crises. I construct two sub-samples for the periods 1997q3-2007q3 and 2007q4-2016q4, to represent the transition from the Asian financial crisis and the global financial crisis, respectively. Thereafter, I analyse the causal relationship between the policy variables and the target variables.

The significance of magnifying the two financial crises in the analysis is because most financial crises can result in a feedback loop between the real economy and the financial sector, which can impair the transmission of monetary policy and macroprudential policy. It is therefore important for emerging economies to develop a policy mix that can successfully alleviate the effects of a financial crisis. The empirical findings indicate that tightening the two policies during the global financial crisis, has a higher cost on the economy than during the Asian financial crisis. This is because in addition to the general effects of the global financial crisis, the policy shocks significantly dampen both the real economy and the financial sector.

Unlike the Asian financial crisis²³ which originated in emerging economies, the global financial crisis²⁴ spread from developed countries to the emerging economies primarily through financial flows and trade. The global financial crisis had a large impact on most of the emerging economies because of their strong links with the global economy. For instance, given that most emerging economies have a large number of foreign owned banks and weak financial regulations, the collapse in the finance centres of developed countries was promptly transmitted to the financial sectors in emerging economies. Contrary to the expectation that the effects of the Asian financial crisis were more pronounced in the BRICS economies, the existing literature indicates that the consequences of the crisis on the countries were very minimal and it only affected a few countries in Asia. For example, China was able to maintain high economic growth during the Asian financial crisis and offered financial aid to other countries such as Thailand. Some scholars argue that China was able to avoid the adverse effects of the Asian crisis because the lack of financial liberalization in the country at the time limited its vulnerability to the crisis. The literature documents that the BRICS economies were however badly affected by the global financial crisis (Janssen et al., 2019).

6.2 Effect of a macroprudential policy shock

The effects of the macroprudential policy shock differ between the two financial crises. Table 3 indicates that during the Asian financial crisis, the policy shock was associated with lower economic costs because the effect was only limited to a decrease in total credit. An increase of 1 percent in the macroprudential policy index caused a decrease of approximately 2.2 percent in the total credit. By contrast, Table 4 shows that the effects of the macroprudential policy shock during the global financial crisis were transmitted to output, total credit and house prices. A 1 percent increase in the macroprudential policy index caused total credit and house prices to decrease by 0.17 percent and 0.11 percent, respectively. The negative effect on total credit and house prices amplifies the effects of the global financial crisis. On the other hand, the policy shock stimulates economic activity by increasing output by approximately 0.1 percent. The increase in output is however not enough to offset the economic cost of the crisis. Figures B2 and B3 support this notion and indicate that the effect of a contractionary macroprudential policy shock on house prices and total credit is significantly negative after the second period.

²³The Asian financial crisis was caused by an unsustainable current account deficit that emanated from a fixed exchange rate arrangement in Thailand. The unsustainable current account deficit reflected an overvalued Thai currency due to rising prices and the appreciation of the US dollar. Over time the fixed exchange rate system therefore became unsustainable, resulting in a fall in the value of the Thai currency and widespread bankruptcies (Lauridsen, 1998).

²⁴The global financial crisis started as a mortgage crisis in the US. It was triggered by a lax in the mortgage lending standards which resulted in the excess supply of housing and resulted in a housing bubble due to inflated prices. A sudden fall in the housing prices therefore caused a global financial crisis due to the vulnerability of the household sector to a fall in housing prices (Ellis, 2010).

TABLE 3: Estimated granger causality for the dynamic panel system GMM (Asian financial crisis)

	Dependent Variables (response variables)			
	drgdp	dcpi	dtrcr_to_gdp	dhouseprices
$dmpi_{t-1}$	0.7294 (0.022)	0.9684 (0.024)	-2.1836*** (0.040)	0.2813 (0.043)
dr_{t-1}	-0.1100 (0.022)	0.4905** (0.024)	0.0248 (0.040)	-0.2088 (0.043)

Notes.- The table shows the causal relationship between the policy variables and the macroeconomic and financial variables, during the transition from the Asian financial crisis. The sub-sample consists of the period during and after the Asian financial crisis (1997q3 - 2007q3). ***, **, * indicate the statistical significance at 1 percent, 5 percent and 10 percent levels respectively.

TABLE 4: Estimated granger causality for the dynamic panel system GMM (Global financial crisis)

	Dependent Variables (response variables)			
	drgdp	dcpi	dtrcr_to_gdp	dhouseprices
$dmpi_{t-1}$	0.0733*** (0.022)	0.0201 (0.024)	-0.1668*** (0.040)	-0.1113*** (0.043)
dr_{t-1}	-0.1979*** (0.022)	0.2946*** (0.024)	-0.4373*** (0.040)	-0.5632*** (0.043)

Note.- The table shows the causal relationship between the policy variables and the macroeconomic and financial variables, during the transition from the global financial crisis. The sub-sample consists of the period during and after the global financial crisis (2007q4 - 2016q4). ***, **, * indicate the statistical significance at 1 percent, 5 percent and 10 percent levels respectively.

6.3 Effect of a monetary policy shock

Table 3 indicates that following a monetary policy shock, the effect of the Asian financial crisis is associated with a 0.5 percent increase in inflation. The rise in inflation during the Asian financial crisis indicates that the monetary policy shock mitigates the adverse effects of the crisis that dampen prices. Furthermore, the monetary policy shock has no significant effect on output and the financial sector, which further confirm that the economic costs during the Asian financial crisis were minimal. During the transition from the global financial crisis in Table 4, monetary policy has a causal effect on both the real economy and the financial sector. For instance, a 1 percent increase in the policy interest rate causes a decrease of about 0.44 percent and 0.56 percent in total credit and house prices, respectively. In addition, the impulse response functions in Figures B4 and B5, suggest that the effects of the monetary policy shock are amplified during the global financial crisis.

Overall, there are two lines of thought in the literature related to the effect of policy shocks during a financial crisis. The first group of scholars argue that policy shocks have a very limited effect on the macroeconomic and financial variables during a financial crisis. They suggest that during a financial crisis, most economies do not have the policy space to implement countercyclical policies. The second argument is by scholars such as Dahlhaus (2017). It supports the notion that policy shocks have a large effect on the macroeconomic and financial variables during a financial crisis. The proponents of this line of thought argue that this is typically the case when the central bank uses other policies such as fiscal policy, to ease the

negative effects of the financial crisis. For instance, even though emerging economies were improving their regulation of the financial sector before the Asian financial crisis, the regulatory system was not sufficient to prevent the build-up of financial imbalances (Akyüz, 2000). This reflects the limitations of macroprudential policy in some instances, hence in some cases, interventions from alternative policies such as fiscal policy is important. However, the consensus amongst both scholars is that the macroeconomic policy framework where the monetary policy instrument is adjusted in response to deviations in expected inflation and the output gap, is inefficient. They suggest that the framework has to be complemented by attaching a weight to financial stability concerns. Consistent with this recommendation, I suggest that regulating authorities should adopt a policy mix of expansionary monetary and macroprudential policies, in order to stimulate the economy and reduce the economic costs associated with financial crises.

7 Robustness Tests

7.1 Cholesky Ordering

I examine the robustness of the results in the baseline model by relaxing the assumption that the macroprudential and monetary policy variables do not affect the target variables contemporaneously. I therefore change the Cholesky ordering of the endogenous variables. The two policy variables are therefore allowed to be contemporaneously exogenous. The monetary policy variable (r) is ordered first, while the macroprudential policy variable (mpi) is ordered second, followed by the rest of the macroeconomic and financial variables. I find that the impulse response functions are robust to the alternative orderings of the endogenous variables (Figures B6 and B7).

7.2 Dropping countries from the sample

I further check the robustness of the results by dropping one country at a time from the sample. The change in the results is very minimal, except when I drop Russia from the sample. Excluding Russia from the sample eliminates the price puzzle when I re-estimate the effect of the monetary policy shock on the target variables (Figure B8). The estimated granger causality in Table B2 when Russia is dropped from the sample indicates that the impact of the monetary policy shock on output and prices is amplified. In the re-estimated equation, a 1 percent increase in the policy interest rate causes a decrease in the growth of output and prices by 0.45 percent and 0.40 percent, respectively. The negative relationship between the policy interest rate and the measure of inflation suggests that the price puzzle is resolved.

Considering the history of the monetary policy regime in Russia, the results support the literature by Rusnak et al. (2013), who indicate that the price puzzle can be caused by a dataset that has countries with different monetary policy regimes. For instance, assuming that all the countries in the sample exclusively use the policy interest rate to target inflation, even though during some periods in the sample, some countries also operated exchange rate or monetary targeting. In the case of the BRICS economies, the central bank of Russia intervened regularly during the sample period, to prevent sharp fluctuations in the exchange rate. Vdovichenko and Voronina (2006) document that although Russia officially declared that it operates the inflation targeting regime, over the years, some parts of the country's monetary policy has also relied on exchange rate targeting. Giblova (2015) further reports that exchange rate stability is a priority for Russia,

in order to combat the 'Dutch disease'²⁵. This is because the country heavily relies on mineral exports. The central bank in Russia therefore, occasionally uses foreign exchange interventions to prevent excessive appreciation of its currency. Consequently, the exchange rate stability goal sometimes dominates the central bank's other goals, such as price stability. This is because the volume of the foreign exchange interventions is determined externally by uncontrolled factors, for example, world oil prices, which then outweigh other monetary policy instruments that the Bank of Russia uses to control prices. Over the years, the policy mix in Russia has limited the ability of the central to use the interest rate channel and most of the macroeconomic conditions were determined by external conditions, which resulted in very high inflation rates. However, post the 2007/2008 global financial crisis, the Bank of Russia has been working on the transition to a monetary policy regime that prioritises inflation targeting and a floating exchange rate regime.

7.3 Lagged Shocks

I also re-estimate the results with lagged shocks. The granger causality estimates in Table B3 indicate that although the price puzzle is also resolved when the shocks are lagged by one period, the change in the other variables is very minimal when compared with the results from the baseline model, which implies that the impact of the shocks is not amplified (Figures B9 and B10). With regard to inflation, the results suggest that the impact of the monetary policy shock operates with a lag in the BRICS economies. The results are in line with the research by Batini and Nelson (2001), who reaffirm the findings by Friedman (1961) and document that the effect of monetary policy actions on inflation takes over a year. The authors also reiterate that the delay in the reaction of inflation is evident, regardless of the monetary policy regimes that the different countries operate. More specifically, the lagged effect of the monetary policy actions on inflation is pronounced across economies that operate either inflation targeting or monetary aggregates. The authors provide a rationalisation that the lagged effect is partly because of the legal obstacles to changes in prices. Overall, this supports the notion that the response of prices is sluggish compared to output following a monetary policy shock.

7.4 Money Supply Shock

In addition, I replace the policy interest rate with other monetary variables and re-estimate the model. In this case I use the money supply²⁶. There is a notable change in the impulse response of inflation, credit growth and the growth of house prices following a shock in the money supply (Figure B11). While credit growth and the growth of house prices are affected in the expected direction, it is also evident that most of the variations in inflation are explained by changes in the money supply. However, Balke (2000) documents that even though in the past years, changes in money supply have served as a measure of monetary policy, the variable can change for reasons that have nothing to do with monetary policy. For instance, money supply can be influenced by the behaviour of banks and individuals, which in turn are affected by economic conditions. The decline in money supply could therefore, be a result of cautious lending practices by banks to limit the share of non-performing loans. According to WorldBank (2017), bank lending among BRICS economies swelled from 98 percent of GDP to 128 percent of GDP in 2016. Such activity is therefore vulnerable to swings in the credit cycle and can lead to heightened financial stress among companies and result in difficulties for them to repay their debt, hence pushing up non-performing loans. In this case, banks

²⁵This is a phenomenon where an economy that relies on mineral exports experiences a significant appreciation in its domestic currency, which discourages exports in other sectors of the economy because of cheaper import alternatives.

²⁶The money supply is proxied by M3 considering the availability of data. Broad money (M3) includes deposits, currency and deposits that are redeemable at three months (Ibrahim and Amin, 2005).

may therefore prefer to restrict the volume of loans granted, which will have an effect on the money supply. The changes in money supply therefore represent a combination of both supply and demand factors and do not always reflect the actions of the central bank. Several economists such as [Bernanke and Blinder \(1992\)](#), have also argued that movements in the policy interest rate are a better indicator of changes in monetary policy than money supply.

7.5 Exchange Rate Shock

In the second scenario, I replace the policy interest rate with the exchange rate²⁷. This is in part, to confirm the findings by [Kutu and Ngalawa \(2016\)](#), in their research on monetary policy shocks in the BRICS economies. The authors report that, the fluctuations in the inflation rate are mostly due to the exchange rate shocks. It is therefore important to investigate how the alteration affects the results. Figure B12 reveals that a shock in the exchange rate (devaluation/depreciation) generally increases output. The rise in output following a depreciation of the domestic currency coincides with the economic theory, which highlights that a devaluation boosts exports and output growth. In this case, firms adjust to the increased demand in exports by increasing production ([Haddad and Pancaro, 2010](#)). It is however important to interpret the results with caution because the error bands are wider compared to the case of the policy interest rate. This implies that, the exchange rate has a limited effect in explaining the variations in output.

It is also observed that, a 'surprise' depreciation in the exchange rate by the monetary authorities with the intention to boost output, will have a contractionary impact on inflation. The decrease in inflation may be due to the suppressed demand for imports as the domestic currency weakens and import prices rise. Furthermore, there is a sharp decrease in the total credit after an exchange rate shock. [Serena and Sousa \(2017\)](#) support this finding and emphasise that, this is especially the case when a large proportion of the credit in the emerging economies is in foreign denominations. The authors highlight that, the interaction between the exchange rate depreciation and credit issued in foreign currency is negative. This is also consistent with the observation that, hedging long-term credit against the exchange rate risk is more difficult or costly. Considering the impulse responses to the exchange rate shock, it may suggest that the central banks in the emerging economies adjust their monetary policy stance to influence capital flows, which then affects the exchange rate rather than using the exchange rate as the main monetary policy tool ([Kutu and Ngalawa, 2016](#)). This is in line with the viewpoint of [Bhuiyan \(2008\)](#), [Gorodnichenko et al. \(2021\)](#) and [Mishkin \(1996\)](#), who state that the exchange rate has a significant role in the transmission of monetary policy.

²⁷The exchange rate is the value of the domestic currency in terms of the currency of a foreign country. For this paper, the domestic currencies are expressed in terms of the US dollar, given that it is the commonly used currency in foreign markets.

8 Conclusion

To the best of my knowledge, this is the first study to use the dataset by [Alam et al. \(2019\)](#) to examine the macroeconomic effects of monetary and macroprudential policy shocks in a setting of the BRICS economies. The focus on emerging market economies is interesting because the economies have more pronounced business and financial cycles. Some of the BRICS countries, such as Russia, are commodity exporters and are therefore prone to shocks from commodity prices ([Claessens et al., 2012](#)). I analyse the effect of the policy shocks by estimating a panel VAR in a system GMM framework for the time period, 1990 to 2016. The research extends the existing literature on emerging economies by using a novel macroprudential dataset.

The main findings suggest that a monetary policy shock results in a trade-off between the price stability and financial stability objectives. The impulse response functions reveal that even though a contractionary monetary policy shock stabilises the financial sector variables, it fails to achieve the price stability objective. The monetary policy shock therefore causes a negative correlation between inflation and the financial sector variables. Under such circumstances, the policy authorities will have to choose between the price stability and financial stability objectives because the response of the policy interest rate required to achieve financial stability is inconsistent with that required for price stability. The findings are closely related to [Svensson \(2018\)](#), who emphasizes that monetary policy should only be used to achieve the financial stability objective following a thorough cost-benefit analysis because in most cases, the costs of "leaning against the wind" outweigh the benefits, especially in terms of output and unemployment.

I also find that even though a contractionary macroprudential policy shock in the BRICS economies plays a major role in the variation of total credit and house prices, it has spillover effects on the real sector through output. However, there is a lag in the stabilising effect of macroprudential policy on output as it initially increases. The initial increase in output is possibly linked to speculative demand by consumers due to the expectation of a further tightening in policy. However, the expectations of the consumers become rational over time and the speculative demand subsides.

Overall, this research does not support the notion that monetary policy should have a dual mandate and achieve the price stability and financial stability objectives. This is because monetary policy achieves the financial stability objective at a cost of price instability. I therefore recommend that each policy should focus on its primary objective. It is however important that in such a case, each policy is not conducted in a vacuum but rather takes account of the spillover effects of the other policy. The two policies should therefore be conducted as complements rather than substitutes, given that monetary policy enhances the effectiveness of macroprudential policy to achieve the financial stability objective. The conduct of the two policies as complements would allow for policymakers to simultaneously achieve stability in both the real sector and the financial sector.

Given that the use of macroprudential policy is at an infant stage, future research on the topic is still warranted, especially in a setting of developing countries within the same region, with focus on the commonly used macroprudential policy instruments and not a wide array of the prudential measures.

References

- Abrigo, M. R., and I. Love.** 2016. “Estimation of Panel Vector Autoregression in Stata: a Package of Programs.” Working Papers 201602, University of Hawaii at Manoa, Department of Economics.
- Agarwal, J., M. Agarwal, A. Agarwal, and Y. Agarwal.** 2018. “The Theory of Money, Wealth and Efficient Currency Markets: Modeling M5 as Money Supply with Crypto-Currency.” *Finance India*, 32(2): , p. 405.
- Akinci, O., and J. Olmstead-Rumsey.** 2018. “How effective are macroprudential policies? An empirical investigation.” *Journal of Financial Intermediation*, 33(C): 33–57.
- Akyüz, Y.** 2000. “Causes and Sources of the Asian Financial Crisis.” Technical report.
- Alam, Z., M. A. Alter, J. Eiseman, M. R. Gelos, M. H. Kang, M. M. Narita, E. Nier, and N. Wang.** 2019. *Digging deeper—Evidence on the effects of macroprudential policies from a new database.* International Monetary Fund.
- Angelini, P., S. Neri, and F. Panetta.** 2012. “Monetary and macroprudential policies.” Working Paper Series 1449, European Central Bank.
- Arellano, M., and S. Bond.** 1991. “Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations.” *The review of economic studies*, 58(2): 277–297.
- Balke, N. S.** 2000. “Credit and Economic Activity: Credit Regimes and Nonlinear Propagation of Shocks.” *The Review of Economics and Statistics*, 82(2): 344–349.
- Balke, N. S., and K. M. Emery.** 1994. “Understanding the price puzzle.” *Economic and Financial Policy Review(Q IV)*: 15–26.
- Batini, N., and E. Nelson.** 2001. “The Lag from Monetary Policy Actions to Inflation: Friedman Revisited.” *Journal of International Finance*, 4(3): 381–400.
- Bean, C. R., M. Paustian, A. Penalver, and T. Taylor.** 2010. “Monetary policy after the fall.” *Proceedings - Economic Policy Symposium - Jackson Hole* 267–328.
- Beau, D., L. Clerc, and B. Mojon.** 2012. “Macro-Prudential Policy and the Conduct of Monetary Policy.” Working papers 390, Banque de France.
- Behn, M., R. Haselmann, and P. Wachtel.** 2016. “Procyclical Capital Regulation and Lending.” *Journal of Finance*, 71(2): 919–956.
- Bernanke, B.** 2009. “The crisis and the policy response: A speech at the Stamp Lecture, London School of Economics, London, England, January 13, 2009.” Speech 442, Board of Governors of the Federal Reserve System (U.S.).
- Bernanke, B. S., and A. S. Blinder.** 1992. “The Federal Funds Rate and the Channels of Monetary Transmission.” *American Economic Review*, 82(4): 901–921.
- Bhuiyan, R.** 2008. “Monetary Transmission Mechanism In A Small Open Economy: A Bayesian Structural VAR Approach.” Working Paper 1183, Economics Department, Queen’s University.
- Blanchard, O., G. Dell’Ariccia, and P. Mauro.** 2014. “Introduction: Rethinking Macro Policy II—Getting Granular.” In *What Have We Learned? Macroeconomic Policy After the Crisis*. 1 of MIT Press Book Chapters The MIT Press, , Chap. 0 1–28.
- Blundell, R., and S. Bond.** 1998. “Initial conditions and moment restrictions in dynamic panel data models.” *Journal of Econometrics*, 87(1): 115–143.
- Boar, C., L. Gambacorta, G. Lombardo, and L. A. Pereira da Silva.** 2017. “What are the effects of macroprudential policies on macroeconomic performance?” *BIS Quarterly Review September*.

- Borio, C.** 2009. “Implementing the macroprudential approach to financial regulation and supervision.” *Financial Stability Review*(13): 31–41.
- Borio, C. E. V., and P. Lowe.** 2004. “Securing sustainable price stability: should credit come back from the wilderness?.” BIS Working Papers 157, Bank for International Settlements.
- Borio, C., and P. Lowe.** 2002. “Assessing the risk of banking crises.” *BIS Quarterly Review*.
- Brunnermeier, M. K., T. M. Eisenbach, and Y. Sannikov.** 2012. “Macroeconomics with Financial Frictions: A Survey.” NBER Working Papers 18102, National Bureau of Economic Research, Inc.
- Bruno, V., I. Shim, and H. S. Shin.** 2017. “Comparative assessment of macroprudential policies.” *Journal of Financial Stability*, 28(C): 183–202.
- Bruno, V., and H. S. Shin.** 2013. “Capital Flows, Cross-Border Banking and Global Liquidity.” NBER Working Papers 19038, National Bureau of Economic Research, Inc.
- Canuto, O., and S. R. Ghosh.** 2013. *Dealing with the Challenges of Macro Financial Linkages in Emerging Markets*. In , World Bank Publications(16202): The World Bank.
- Carboni, G., M. Darracq Pariès, and C. Kok.** 2013. “Exploring the Nexus between Macro-Prudential Policies and Monetary Policy Measures.” *Financial Stability Review*, 1.
- Cerutti, E., S. Claessens, and L. Laeven.** 2016. “The use and effectiveness of macroprudential policies.” In *Macroprudential policy*. Ed. by B. for International Settlements, 86 of BIS Papers chapters Bank for International Settlements, 95–102.
- Cerutti, M. E. M., M. R. Correa, E. Fiorentino, and E. Segalla.** 2016. *Changes in prudential policy instruments—a new cross-country database*. International Monetary Fund.
- Chadwick, M. G.** 2018. “Effectiveness of monetary and macroprudential shocks on consumer credit growth and volatility in Turkey.” *Central Bank Review*, 18(2): 69–83.
- Christiano, L. J., M. Eichenbaum, and C. L. Evans.** 1999. “Monetary policy shocks: What have we learned and to what end?.” In *Handbook of Macroeconomics*. Eds. by J. B. Taylor, and M. Woodford, 1 of Handbook of Macroeconomics Elsevier, , Chap. 2 65–148.
- Claessens, S., S. R. Ghosh, and R. Mihet.** 2013. “Macro-prudential policies to mitigate financial system vulnerabilities.” *Journal of International Money and Finance*, 39(C): 153–185.
- Claessens, S., M. A. Kose, and M. E. Terrones.** 2012. “How do business and financial cycles interact?.” *Journal of International economics*, 87(1): 178–190.
- Claessens, S., and F. Valencia.** 2013. “The interaction between monetary and macroprudential policies.” *Approved By Olivier Blanchard and José Viñals, IMF*.
- Clement, P.** 2010. “The term “Macroprudential”: Origins and Evolution.” *BIS Quarterly Review*.
- Dahlhaus, T.** 2017. “Conventional Monetary Policy Transmission During Financial Crises: An Empirical Analysis.” *Journal of Applied Econometrics*, 32(2): 401–421.
- Dell’Ariccia, G., P. Rabanal, C. W. Crowe, and D. O. Igan.** 2011. “Policies for Macrofinancial Stability; Options to Deal with Real Estate Booms.” IMF Staff Discussion Notes 2011/002, International Monetary Fund.
- Dembiermont, C., M. Drehmann, and S. Muksakunratana.** 2013. “How much does the private sector really borrow? a new database for total credit to the private non-financial sector.” *BIS Quarterly Review March*.
- Dunstan, A.** 2014. “The interaction between monetary and macro-prudential policy.” *Reserve Bank of New Zealand Bulletin*, 77 15–25.

- Ellis, L.** 2010. “The Housing Meltdown: Why Did It Happen in the United States?.” *International Real Estate Review*, 13(3): 351–394.
- Friedman, M.** 1961. “The lag in effect of monetary policy.” *Journal of Political Economy*, 69 447–447.
- Friedman, M.** 1968. “The role of monetary policy.” *The American Economic Review*, 58(1): 1–17.
- Galí, J., and L. Gambetti.** 2015. “The Effects of Monetary Policy on Stock Market Bubbles: Some Evidence.” *American Economic Journal: Macroeconomics*, 7(1): 233–257.
- Gambacorta, L., and A. M. Pabón.** 2017. “The impact of macroprudential policies and their interaction with monetary policy: an empirical analysis using credit registry data.” BIS Working Papers 636, Bank for International Settlements.
- Gelain, P., and P. Ilbas.** 2017. “Monetary and macroprudential policies in an estimated model with financial intermediation.” *Journal of Economic Dynamics and Control*, 78(C): 164–189.
- Gelain, P., K. J. Lansing, and C. Mendicino.** 2013. “House Prices, Credit Growth, and Excess Volatility: Implications for Monetary and Macroprudential Policy.” *International Journal of Central Banking*, 9(2): 219–276.
- Giblova, N.** 2015. “Monetary policy in Russia: Recent challenges and changes in unstable economic conditions.” *Review of Business and Economics Studies*, 3(1): 57–66.
- Gorodnichenko, Y., T. Pham, and O. Talavera.** 2021. “The Voice of Monetary Policy.” Discussion Papers 21-02, Department of Economics, University of Birmingham.
- Haddad, M., and C. Pancaro.** 2010. “Can Real Exchange Rate Undervaluation Boost Exports and Growth in Developing Countries? Yes, But Not for Long.” World Bank Other Operational Studies 10178, The World Bank.
- Hakkio, C. S.** 2008. “PCE and CPI inflation differentials: converting inflation forecasts.” *Economic Review*, 93(Q I): 51–68.
- Hanson, S. G., A. K. Kashyap, and J. C. Stein.** 2011. “A macroprudential approach to financial regulation.” *Journal of economic Perspectives*, 25(1): 3–28.
- He, D., E. Nier, and H. Kang.** 2016. “Macroprudential measures for addressing housing sector risks.” In *Macroprudential policy*. Ed. by B. for International Settlements, 86 of BIS Papers chapters Bank for International Settlements, 117–122.
- Hollander, H., and D. van Lill.** 2019. “A Review of the South African Reserve Bank’s Financial Stability Policies.” Technical report.
- Holtz-Eakin, D., W. Newey, and H. S. Rosen.** 1988. “Estimating Vector Autoregressions with Panel Data.” *Econometrica*, 56(6): 1371–1395.
- Ibrahim, M. H., and R. M. Amin.** 2005. “Exchange rate, monetary policy and manufacturing output in Malaysia.” *Journal of Economic Cooperation among Islamic Countries*, 26(3): .
- Igan, D. O., and H. Kang.** 2011. “Do Loan-To-Value and Debt-To-Income Limits Work? Evidence From Korea.” IMF Working Papers 2011/297, International Monetary Fund.
- International Monetary Fund.** 2011. “Macroprudential Policy; What Instruments and How to Use them? Lessons From Country Experiences.” IMF Working Papers 2011/238, International Monetary Fund.
- Jannsen, N., G. Potjagailo, and M. H. Wolters.** 2019. “Monetary Policy during Financial Crises: Is the Transmission Mechanism Impaired?.” *International Journal of Central Banking*, 15(4): 81–126.
- Jimenez, G., V. Salas, and J. Saurina.** 2006. “Determinants of collateral.” *Journal of financial economics*, 81(2): 255–281.

- Òscar Jordà, M. Schularick, and A. M. Taylor.** 2011. “When credit bites back: leverage, business cycles, and crises.” Technical report.
- Òscar Jordà, M. Schularick, and A. M. Taylor.** 2015. “Leveraged bubbles.” Working Paper Series 2015-10, Federal Reserve Bank of San Francisco.
- Kaminsky, G. L., and C. M. Reinhart.** 1996. “The twin crises: the causes of banking and balance-of-payments problems.” Technical report.
- Kapoor, S., and M. Kaur.** 2017. “Basel III Norms: A SWOT and TOWS Approach.” *Vision*, 21(3): 250–258.
- Katagiri, M., R. Kato, T. Tsuruga et al.** 2012. “Managing Financial Crises: Lean or Clean?.” Technical report, Institute for Monetary and Economic Studies, Bank of Japan.
- Kendall, R., and T. Ng.** 2013. “The 2012 Policy Targets Agreement: an evolution in flexible inflation targeting in New Zealand.” *Reserve Bank of New Zealand Bulletin*, 76 3–12.
- Kim, S., and A. Mehrotra.** 2017. “Managing price and financial stability objectives in inflation targeting economies in asia and the pacific.” *Journal of Financial Stability*, 29 106–116.
- Kim, S., and A. Mehrotra.** 2019. “Examining macroprudential policy and its macroeconomic effects - some new evidence.” BIS Working Papers 825, Bank for International Settlements.
- Kockerols, T., and C. Kok.** 2019. “Leaning against the wind: macroprudential policy and the financial cycle.” Working Paper Series 2223, European Central Bank.
- Krug, S.** 2018. “The interaction between monetary and macroprudential policy: Should central banks ‘lean against the wind’ to foster macro-financial stability?.” *Economics - The Open-Access, Open-Assessment E-Journal*, 12 1–69.
- Kuttner, K. N., and I. Shim.** 2016. “Can non-interest rate policies stabilize housing markets? evidence from a panel of 57 economies.” *Journal of Financial Stability*, 26 31–44.
- Kutu, A. A., and H. Ngalawa.** 2016. “Monetary Policy Shocks and Industrial Sector Performance in South Africa.” *Journal of Economics and Behavioral Studies*, 8(3): 26–40.
- Lanne, M., and H. Lütkepohl.** 2008. “Identifying Monetary Policy Shocks via Changes in Volatility.” *Journal of Money, Credit and Banking*, 40(6): 1131–1149.
- Lauridsen, L. S.** 1998. “The financial crisis in Thailand: Causes, conduct and consequences?.” *World Development*, 26(8): 1575–1591.
- Lim, C. H., I. Krznar, F. Lipinsky, A. Otani, and X. Wu.** 2013. “The Macroprudential Framework; Policy Responsiveness and Institutional Arrangements.” IMF Working Papers 2013/166, International Monetary Fund.
- Liu, G., and T. Molise.** 2020. “The Optimal Monetary and Macroprudential Policies for the South African Economy.” *South African Journal of Economics*, 88(3): 368–404.
- Love, I., and L. Zicchino.** 2006. “Financial development and dynamic investment behavior: Evidence from panel VAR.” *The Quarterly Review of Economics and Finance*, 46(2): 190–210.
- Matheron, J., and P. Antipa.** 2014. “Interactions between monetary and macroprudential policies.” *Financial Stability Review*(18): 225–240.
- Mian, A., and A. Sufi.** 2015. “Household Debt and Defaults from 2000 to 2010: Facts from Credit Bureau Data.” NBER Working Papers 21203, National Bureau of Economic Research, Inc.
- Mishkin, F. S.** 1996. “The Channels of Monetary Transmission: Lessons for Monetary Policy.” NBER Working Papers 5464, National Bureau of Economic Research, Inc.

- Mishkin, F.** 2011. “How Should Central Banks Respond to Asset-Price Bubbles? The ‘Lean’ versus ‘Clean’ Debate After the GFC.” *RBA Bulletin (Print copy discontinued)* 59–70.
- Nickell, S. J.** 1981. “Biases in Dynamic Models with Fixed Effects.” *Econometrica*, 49(6): 1417–1426.
- Nielsen, G.** 2019. “The Interaction Between Monetary Policy and Macroprudential Policy.” Student Paper.
- Nier, E., L. I. Jácome, J. Osinski, and P. Madrid.** 2011. “Towards Effective Macroprudential Policy Frameworks; An Assessment of Stylized Institutional Models.” IMF Working Papers 2011/250, International Monetary Fund.
- Quint, D., and P. Rabanal.** 2014. “Monetary and Macroprudential Policy in an Estimated DSGE Model of the Euro Area.” *International Journal of Central Banking*, 10(2): 169–236.
- Raputsoane, L.** 2015. “The lean versus clean debate and monetary policy in South Africa.” MPRA Paper 68123, University Library of Munich, Germany.
- Richter, B., M. Schularick, and I. Shim.** 2018. “The macroeconomic effects of macroprudential policy.” BIS Working Papers 740, Bank for International Settlements.
- Roodman, D.** 2009. “How to do xtabond2: An introduction to difference and system GMM in Stata.” *Stata Journal*, 9(1): 86–136.
- Rubio, M., and J. A. Carrasco-Gallego.** 2016. “The new financial regulation in Basel III and monetary policy: A macroprudential approach.” *Journal of Financial Stability*, 26(C): 294–305.
- Rusnak, M., T. Havranek, and R. Horvath.** 2013. “How to Solve the Price Puzzle? A Meta-Analysis.” *Journal of Money, Credit and Banking*, 45(1): 37–70.
- Salas, V., and J. Saurina.** 2002. “Credit risk in two institutional regimes: Spanish commercial and savings banks.” *Journal of Financial Services Research*, 22(3): 203–224.
- Sannikov, Y., and M. Brunnermeier.** 2012. “A Macroeconomic Model with a Financial Sector.” 2012 Meeting Papers 507, Society for Economic Dynamics.
- Schularick, M., and A. M. Taylor.** 2012. “Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008.” *American Economic Review*, 102(2): 1029–1061.
- Serena, J. M., and R. Sousa.** 2017. “Does exchange rate depreciation have contractionary effects on firm-level investment?.” BIS Working Papers 624, Bank for International Settlements.
- Shim, I., B. Bogdanova, J. Shek, and A. Subelyte.** 2013. “Database for policy actions on housing markets.” *BIS Quarterly Review*, September.
- da Silva, L. A. P.** 2016. “Macroprudential policies and integrated inflation targeting.” In *Macroprudential policy*. Ed. by B. for International Settlements, 86 of BIS Papers chapters Bank for International Settlements, v–vi.
- Sims, C. A.** 1992. “Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy.” Cowles Foundation Discussion Papers 1011, Cowles Foundation for Research in Economics, Yale University.
- Smets, F.** 2014. “Financial Stability and Monetary Policy: How Closely Interlinked?.” *International Journal of Central Banking*, 10(2): 263–300.
- Soto, M.** 2009. “System GMM estimation with a small sample.” Working Papers 395, Barcelona Graduate School of Economics.
- Suh, H.** 2014. “Dichotomy between macroprudential policy and monetary policy on credit and inflation.” *Economics Letters*, 122(2): 144–149.

- Svensson, L. E. O.** 2018. “Monetary policy and macroprudential policy: Different and separate?.” *Canadian Journal of Economics*, 51(3): 802–827.
- Svensson, L. E.** 2012. “Practical Monetary Policy: Examples from Sweden and the United States.” NBER Working Papers 17823, National Bureau of Economic Research, Inc.
- Svensson, L. E.** 2017. “Leaning Against the Wind: The Role of Different Assumptions About the Costs.” NBER Working Papers 23745, National Bureau of Economic Research, Inc.
- Taylor, J. B.** 2014. “Monetary Policy and the State of the Economy.” Economics Working Papers 14107, Hoover Institution, Stanford University.
- Tinbergen, J.** 1952. “On the theory of economic policy.” *Books (Jan Tinbergen)*.
- Tobal, M., and L. Menna.** 2020. “Monetary policy and financial stability in emerging market economies.” *Latin American Journal of Central Banking (previously Monetaria)*, 1(1): .
- Trichet, J.-C.** 2009. “Credible alertness revisited.” *Proceedings - Economic Policy Symposium - Jackson Hole* 437–460.
- Turdaliev, N., and Y. Zhang.** 2019. “Household debt, macroprudential rules, and monetary policy.” *Economic Modelling*, 77(C): 234–252.
- Vdovichenko, A., and V. Voronina.** 2006. “Monetary policy rules and their application in Russia.” *Research in International Business and Finance*, 20(2): 145–162.
- Vieira, F. V., and C. G. da Silva.** 2021. “What drives export performance in the BRICS countries? An ARDL investigation.” *Economics Bulletin*, 41(2): 686–695.
- Viswanathan, K.** 2010. “The global financial crisis and its impact on India.” *J. Int’l Bus. & L.*, 9, p. 41.
- Vo, Q.-A.** 2021. “Interactions of capital and liquidity requirements: a review of the literature.” Bank of England working papers 916, Bank of England.
- Wilson, D., and R. Purushothaman.** 2006. “Dreaming With BRICs: The Path to 2050.” In *Emerging Economies and the Transformation of International Business*. Ed. by S. C. Jain Edward Elgar Publishing, , Chap. 1.
- Woodford, M.** 2012. “Methods of policy accommodation at the interest-rate lower bound.” *Proceedings - Economic Policy Symposium - Jackson Hole* 185–288.
- WorldBank.** 2017. *International Debt Statistics 2017*. In , World Bank Publications(25697): The World Bank.
- Yang, L. Y., T. Yue, J. L. Ding, and T. Han.** 2012. “A comparison of disciplinary structure in science between the G7 and the BRIC countries by bibliometric methods.” *Scientometrics*, 93(2): 497–516.
- Yellen, J. L.** 2009. “Linkages between monetary and regulatory policy: lessons from the crisis.” Speech 78, Federal Reserve Bank of San Francisco.
- Yoon, D. R., and S. B. Kim.** 2013. “G20 St. Petersburg Summit Outcomes and Future Tasks.” World Economy Brief 13-51, Korea Institute for International Economic Policy.
- Zdzienicka, A., S. Chen, F. D. Kalan, S. Laseen, and K. Svirydzhenka.** 2015. “Effects of Monetary and Macroprudential Policies on Financial Conditions; Evidence from the United States.” IMF Working Papers 2015/288, International Monetary Fund.
- Zhang, A., M. Pan, B. Liu, and Y.-C. Weng.** 2020. “Systemic risk: The coordination of macroprudential and monetary policies in China.” *Economic Modelling*, 93(C): 415–429.

Appendix A. Integrated Macprudential Policy (iMaPP) Variables

TABLE A1: The iMaPP database variable classifications

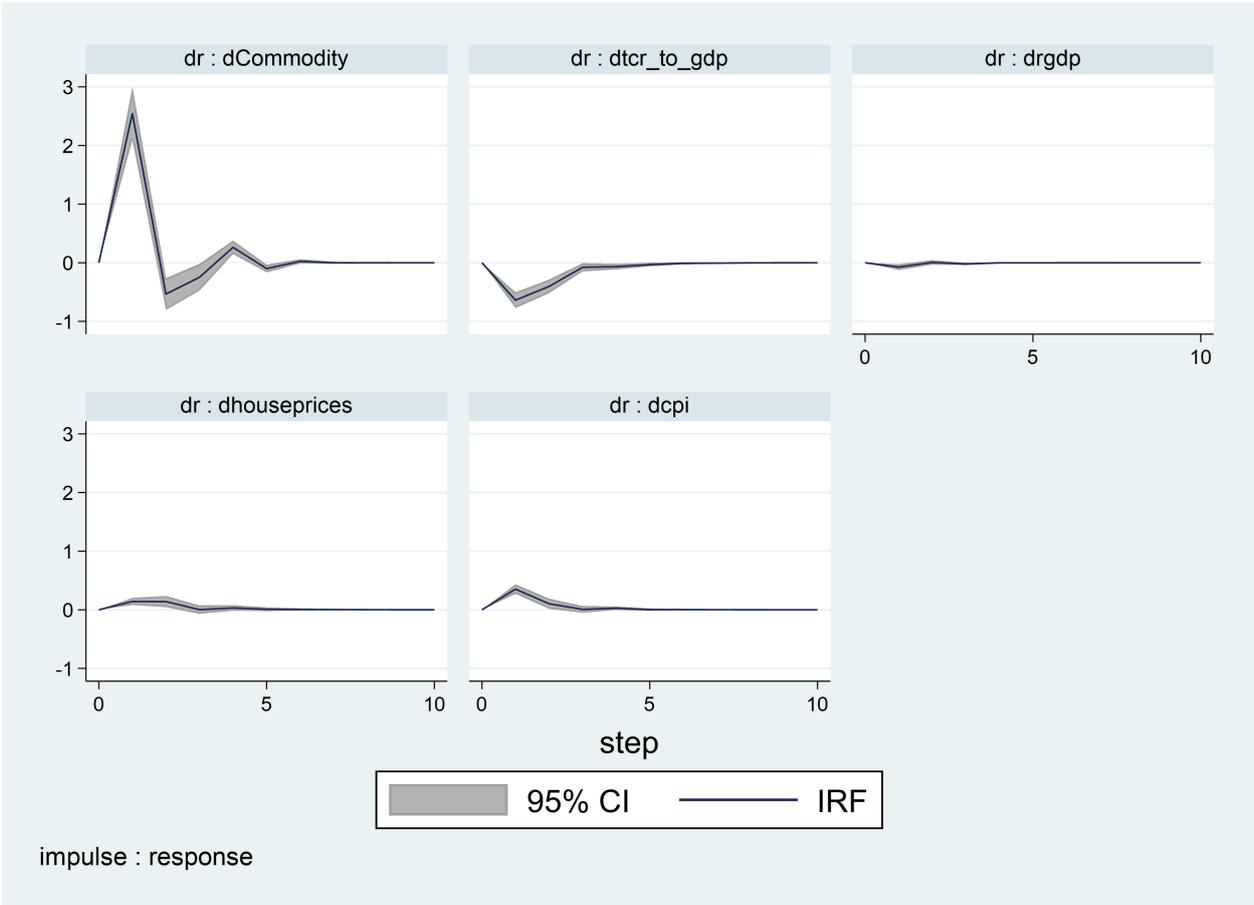
	Classifications
1	Counter-cyclical capital buffer
2	Capital conservation buffer
3	Capital requirements
4	Leverage ratio
5	Loan loss provision
6	Limits on credit growth
7	Loan restrictions
8	Limits on foreign currency
9	Loan-to-value ratios
10	Debt-service-to-income ratio
11	Taxes and levies on specific transactions
12	Liquidity requirements
13	Loan-to-deposit ratio
14	Limits on foreign exchange positions
15	Reserve requirements
16	Capital and liquidity surcharge on systemically important financial institutions
17	Other

Notes.- The table shows the classifications of the macroprudential policy variables in the iMaPP database. The variables are classified into 17 categories, for 134 countries over the 1990-2016 period.

Source: [Alam et al. \(2019\)](#)

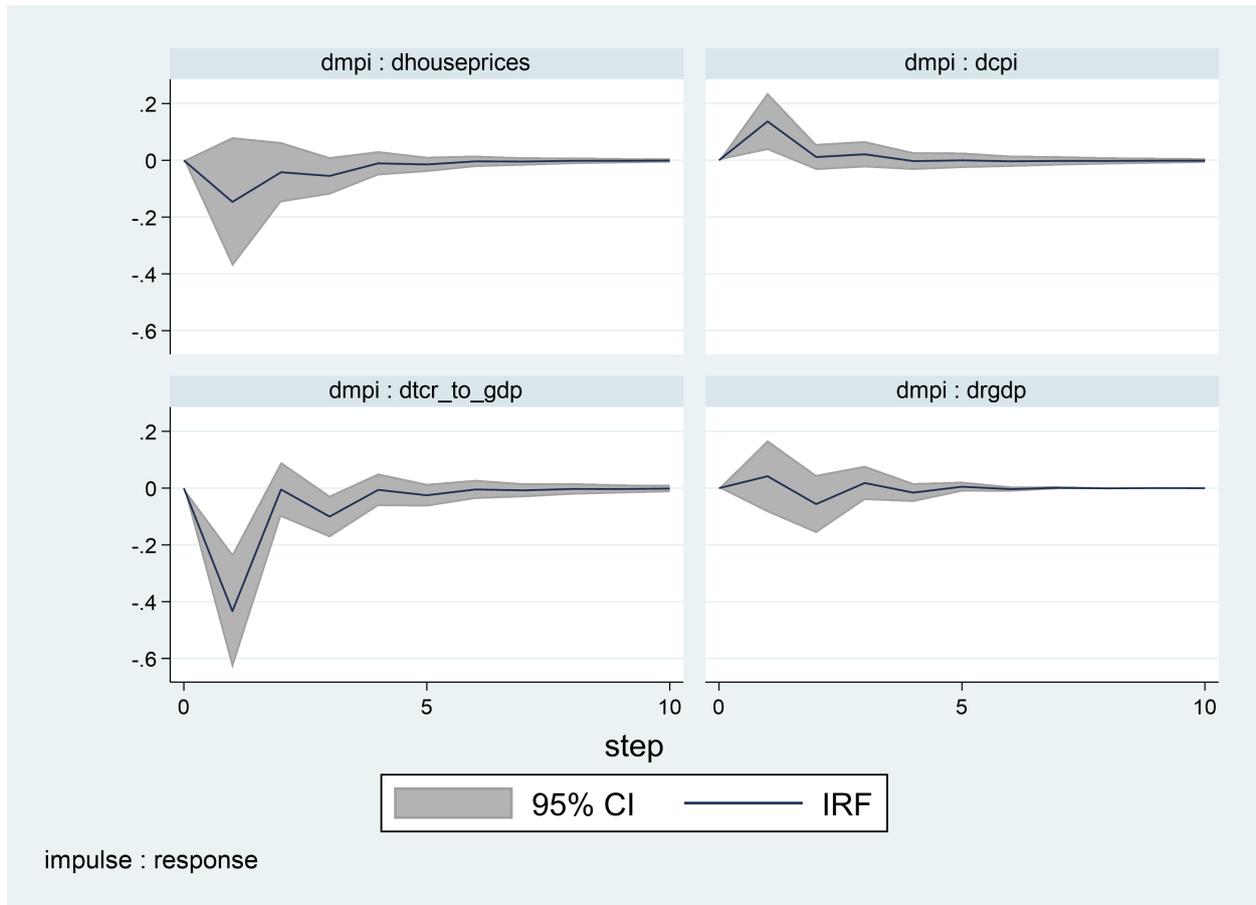
Appendix B. Figures and Tables

FIGURE B1: Impulse responses to monetary policy shock (Extended model with commodity prices)



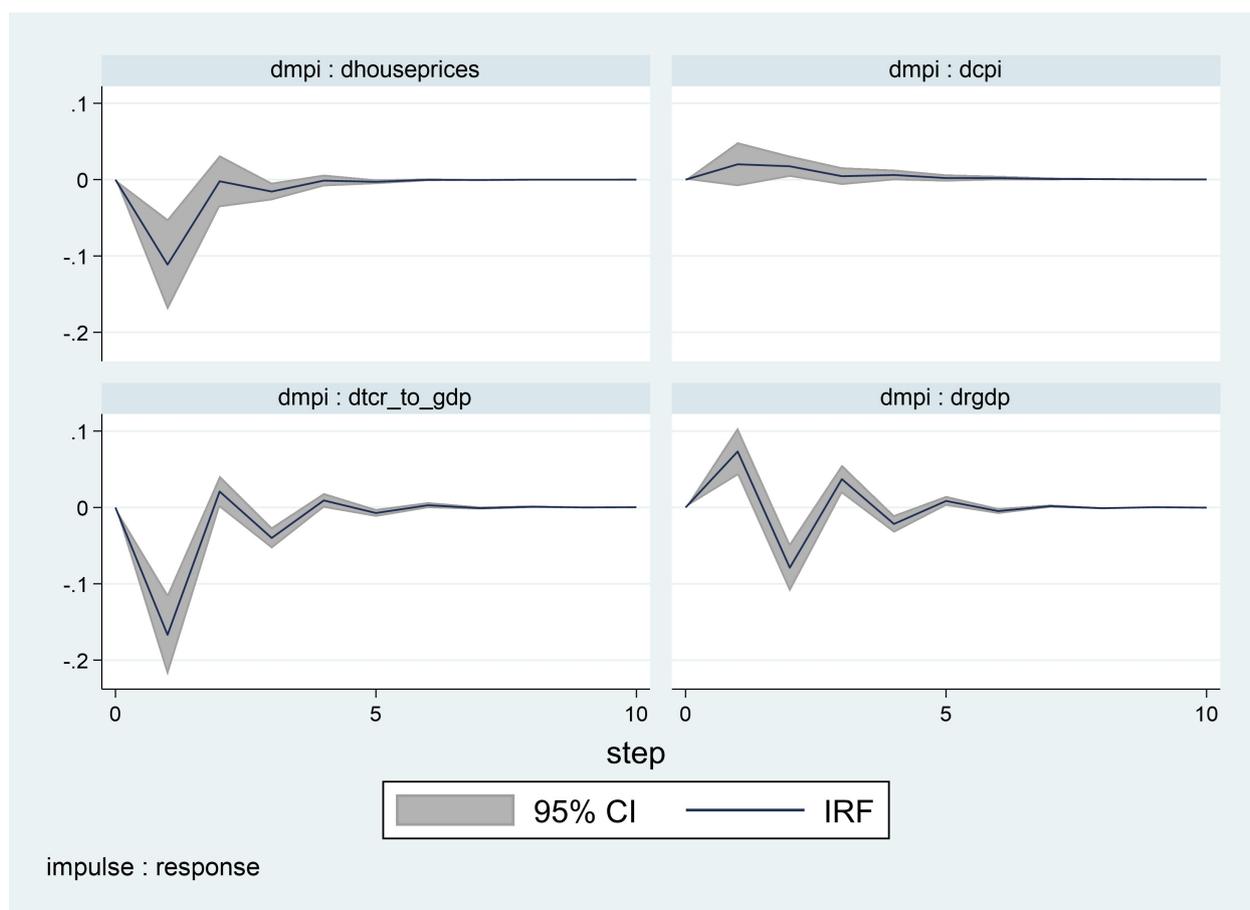
Notes.- The impulse response of commodity prices, total credit-to-GDP (tcr_to_gdp), real GDP (rgdp), house prices and inflation (cpi), to a monetary policy shock. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B2: Impulse responses to macroprudential policy shock (Asian financial crisis)



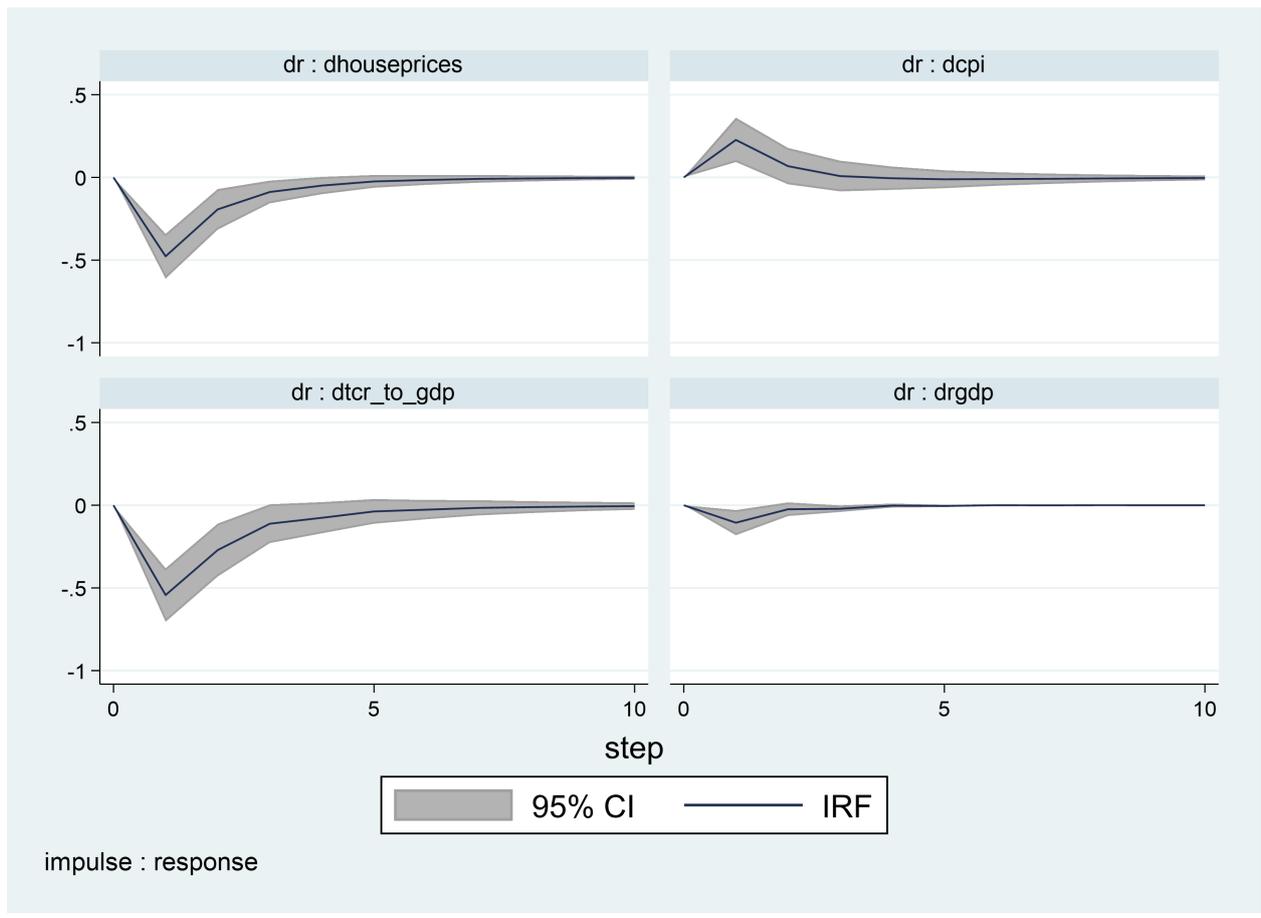
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a macroprudential policy shock during and after the Asian financial crisis (1997q3 - 2007q3). The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B3: Impulse responses to macroprudential policy shock (Global financial crisis)



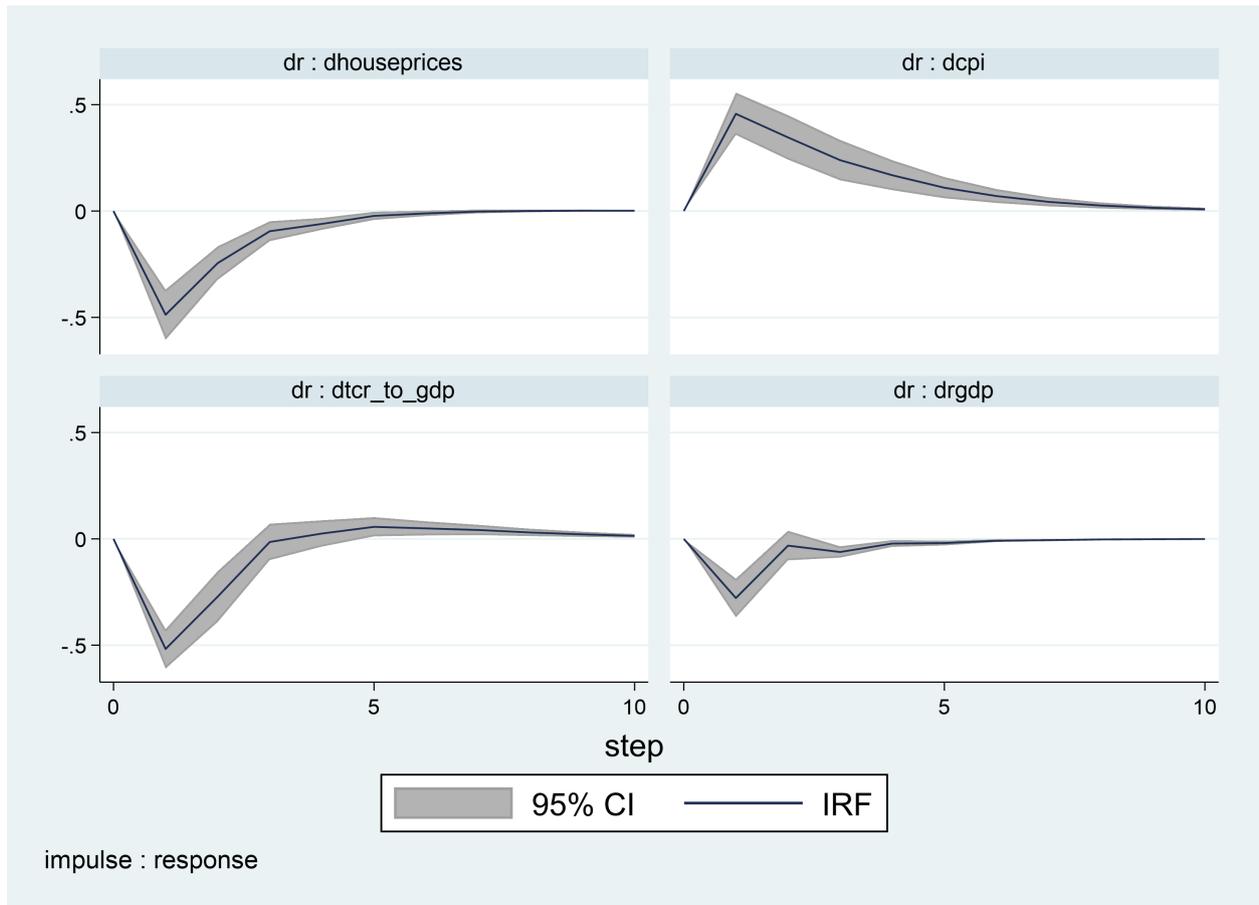
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a macroprudential policy shock during and after the global financial crisis (2007q4 - 2016q4). The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B4: Impulse responses to monetary policy shock (Asian financial crisis)



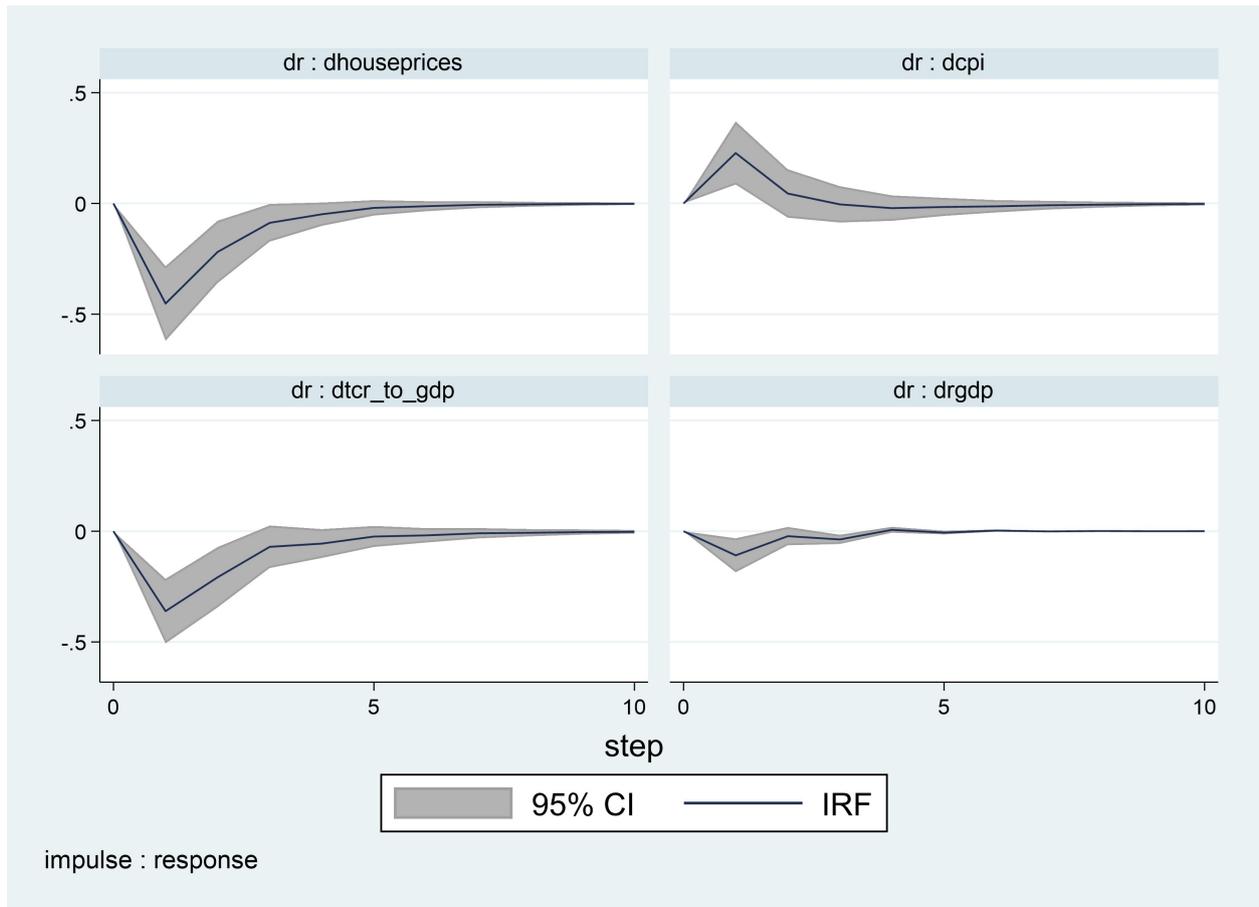
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a monetary policy shock during and after the Asian financial crisis (1997q3 - 2007q3). The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B5: Impulse responses to monetary policy shock (Global financial crisis)



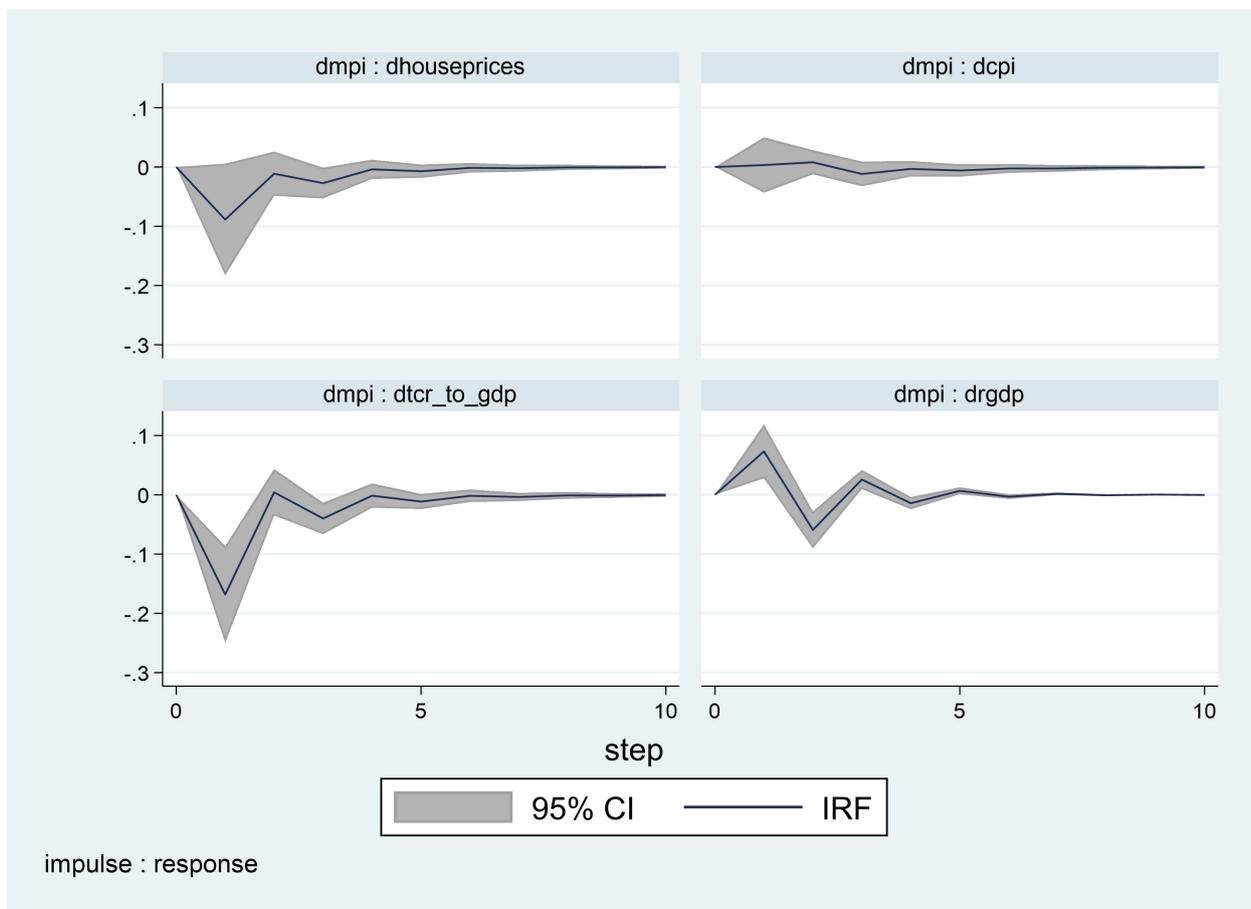
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a monetary policy shock during and after the global financial crisis (2007q4 - 2016q4). The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B6: Impulse responses to monetary policy shock (Different cholesky ordering)



Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a monetary policy shock following a change in the cholesky ordering of the variables. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B7: Impulse responses to macroprudential policy shock (Different cholesky ordering)



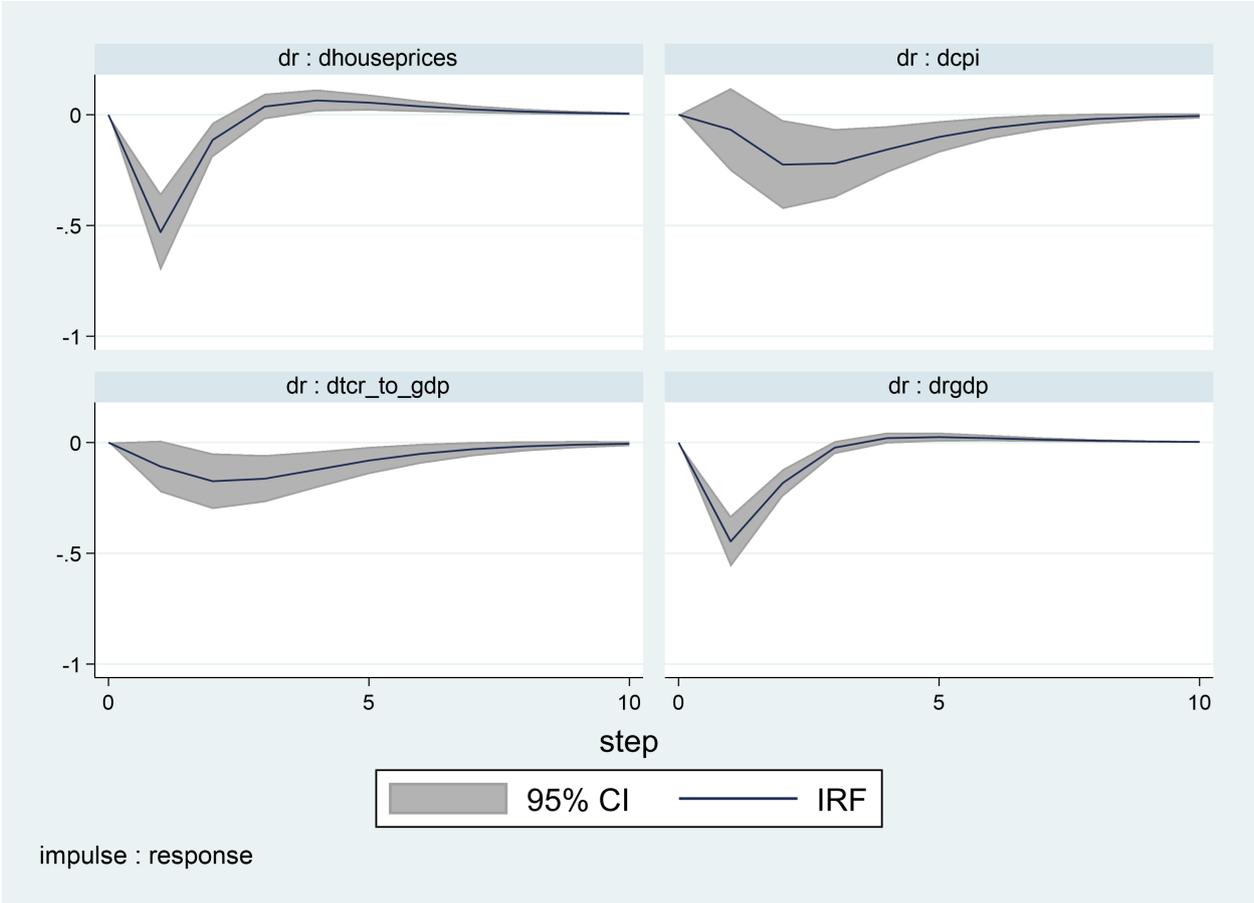
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a macroprudential policy shock following a change in the cholesky ordering of the variables. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

TABLE B2: Estimated granger causality for the dynamic panel system GMM (Dropping Russia from the sample)

	Dependent Variables (response variables)			
	drgdp	dcpi	dtr_to_gdp	dhouseprices
$dmpi_{t-1}$	0.034* (0.021)	0.009 (0.020)	-0.064** (0.032)	-0.050 (0.033)
dr_{t-1}	-0.446*** (0.060)	-0.403*** (0.095)	-0.108* (0.056)	-0.530*** (0.089)

Notes.- The table shows the causal relationship between the policy variables and the macroeconomic and financial variables, when Russia is removed from the sample. ***, **, * indicate the statistical significance at 1 percent, 5 percent and 10 percent levels respectively.

FIGURE B8: Impulse responses to monetary policy shock (Dropping Russia from the sample)



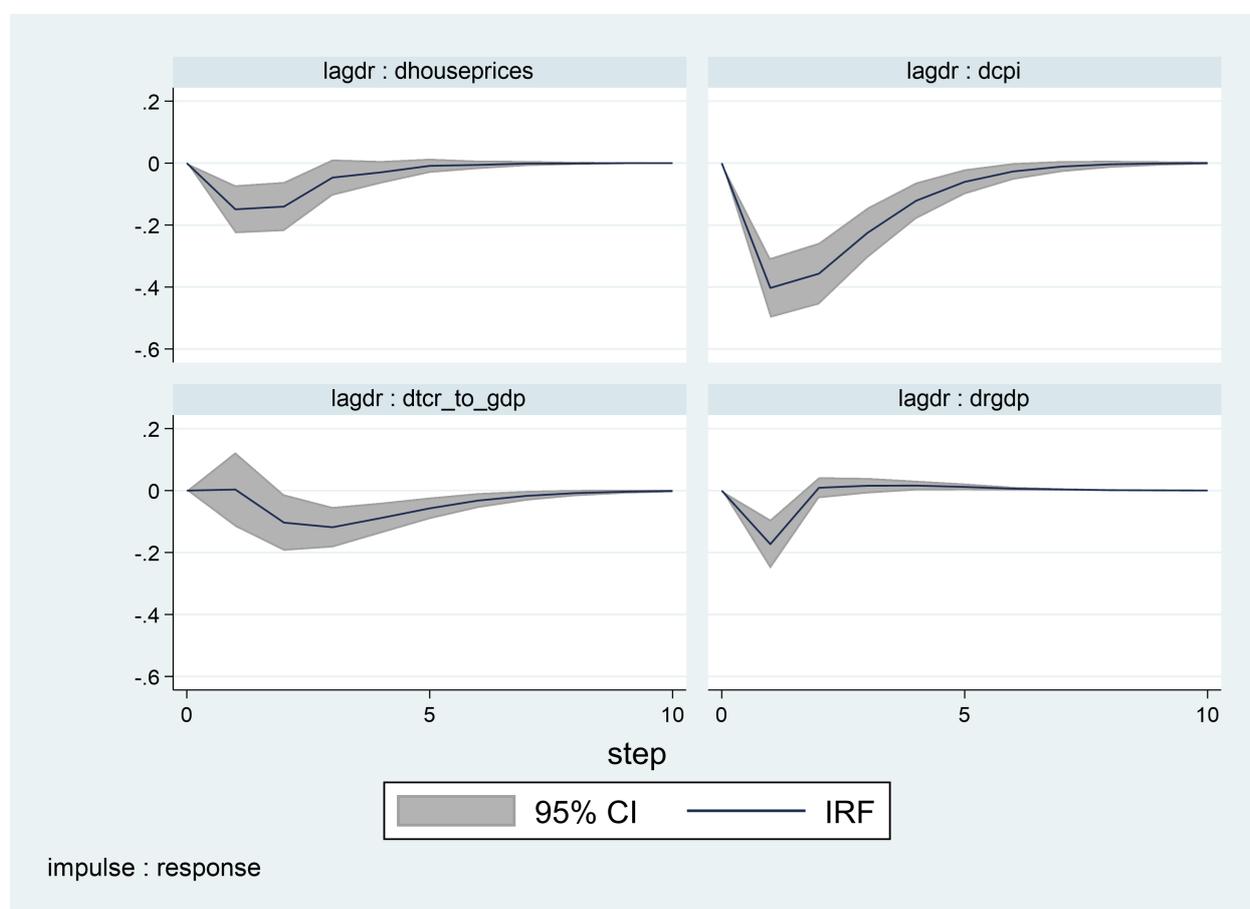
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tr_to_gdp), to a monetary policy shock after dropping Russia from the sample. The impulse response indicates a negative relationship between the monetary policy action and inflation, which implies that the price puzzle is eliminated when Russia is removed from the sample. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

TABLE B3: Estimated granger causality for the dynamic panel system GMM (Lagged shocks)

	Dependent Variables (response variables)			
	drgdp	dcpi	dtrcr_to_gdp	dhouseprices
$dmpi_{t-1}$	-0.038 (0.024)	-0.003 (0.030)	0.017 (0.041)	-0.102*** (0.032)
dr_{t-1}	-0.173*** (0.041)	-0.068*** (0.095)	0.003 (0.060)	-0.149*** (0.039)

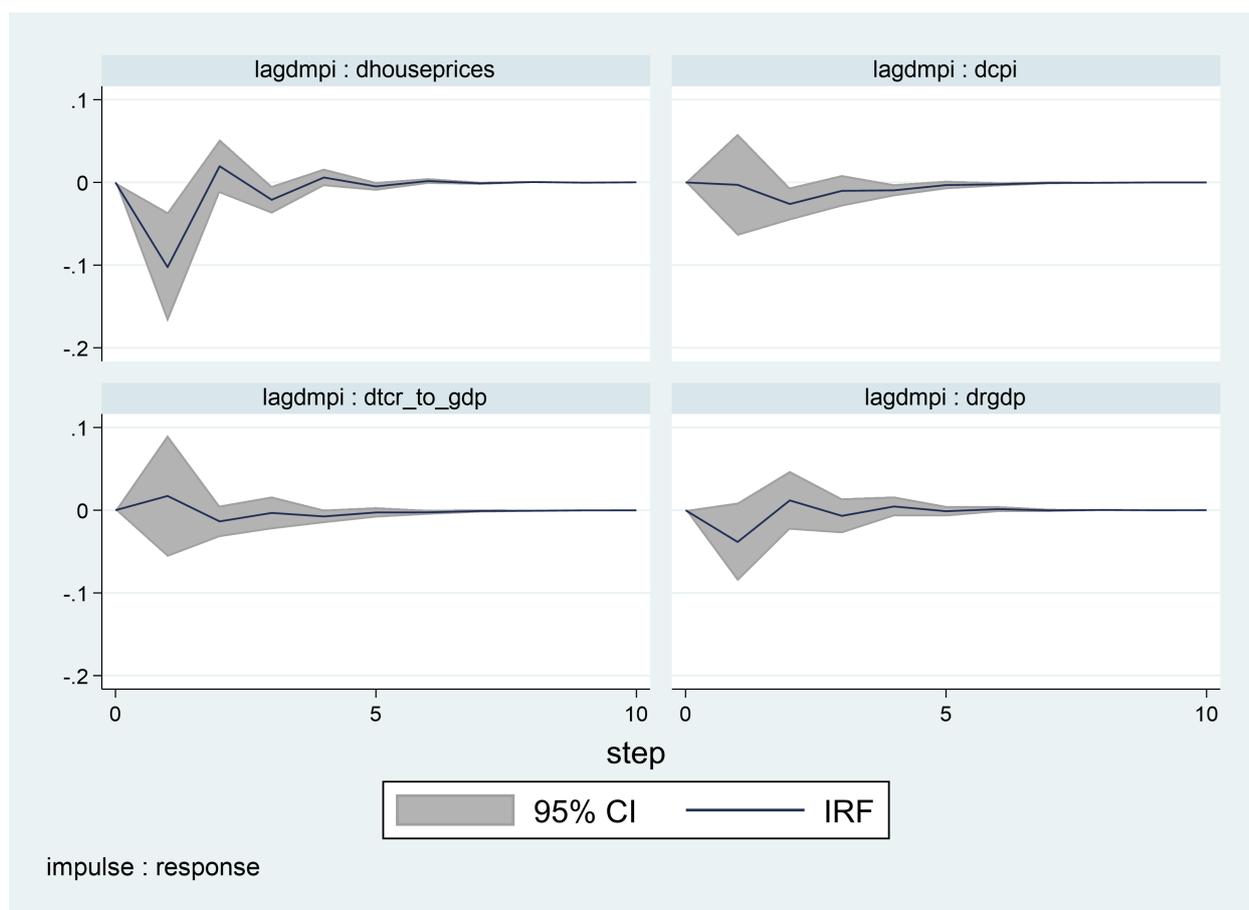
Notes.- The table shows the causal relationship between the policy variables and the macroeconomic and financial variables, when the monetary policy shock and the macroprudential policy shock are lagged by one period. ***, **, * indicate the statistical significance at 1 percent, 5 percent and 10 percent levels respectively.

FIGURE B9: Impulse responses to monetary policy shock (Lagged shocks)



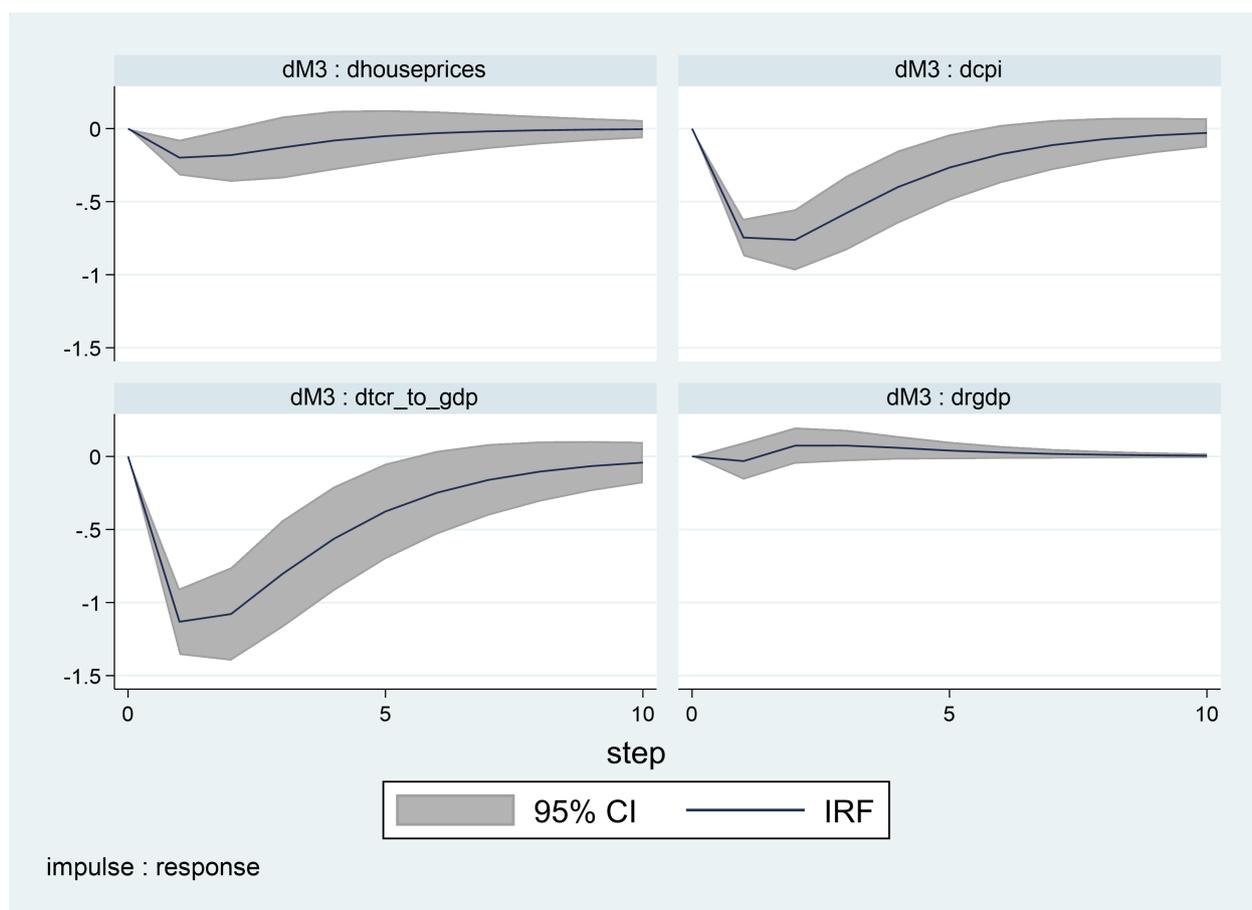
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (trcr_to_gdp), to a monetary policy shock when the shock is lagged by one period. The results indicate that the price puzzle disappears when the monetary policy shock is lagged by one period. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B10: Impulse responses to macroprudential policy shock (Lagged shocks)



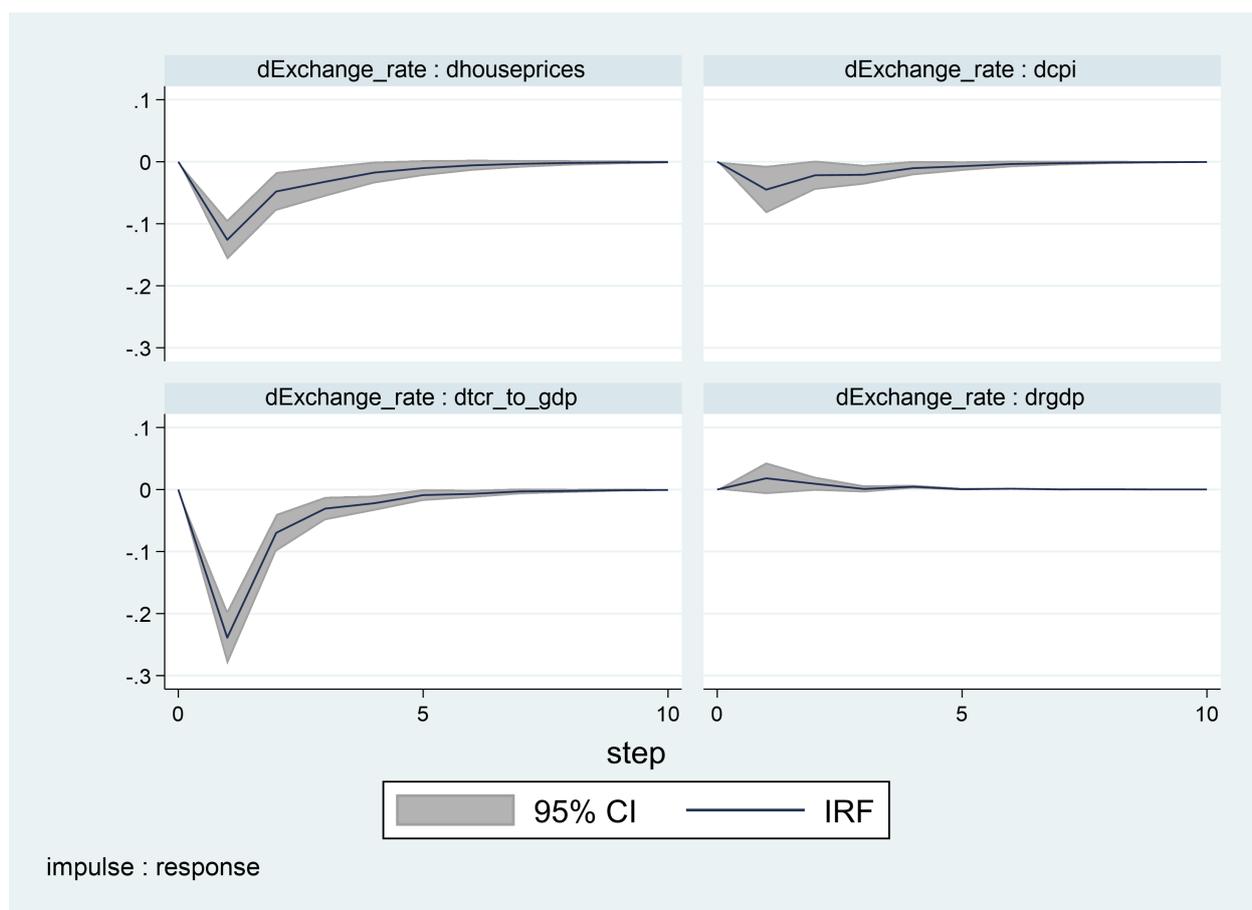
Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a macroprudential policy shock, when the shock is lagged by one period. The results are similar to those in the baseline model. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B11: Impulse responses to money supply shock



Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to a money supply shock. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.

FIGURE B12: Impulse responses to exchange rate shock



Notes.- The impulse response of inflation (cpi), real GDP (rgdp), house prices and total credit-to-GDP (tcr_to_gdp), to an exchange rate shock. The shaded area represents the 95 percent confidence interval band, based on the Monte Carlo simulations.