UNCONVENTIONAL MONETARY POLICY IMPLEMENTATION IN TURKEY

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ABSTRACT

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Ph.D. Program in Economics

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This thesis provides an evaluation of the monetary policy implementation of the Central Bank of the Republic of Turkey (CBRT) after 2008 financial crisis. The global financial crisis constitutes a turning point in the central banking practices so much that it can be referred as before and after 2008. We have analysed the effectiveness of the new policy tools of the CBRT in the framework of unconventional monetary policy implementation and with a macroprudential approach. The transmission mechanism of the new policy framework is explained in a very neat open economy DSGE model. The effectiveness of the policy is empirically tested by using a Bayesian SVAR model. The results reveal that the new policy framework is very effective in curbing the volatility in the exchange rates, in improving the current account balance and in limiting the credit growth.

Keywords: Unconventional, Monetary Policy, DSGE, Bayesian SVAR, Reserve Requirements, Interest Rate Corridor.

ÖZET

TÜRKİYE'DE GELENEKSEL OLMAYAN PARA POLİTİKASI UYGULAMALARI

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Nisan, 2022

Bu çalışma, Türkiye Cumhuriyet Merkez Bankası (TCMB)'nın 2008 Finansal Krizinden sonraki para politikası uygulamalarının detaylı bir değerlendirmesini sunmaktadır. Küresel finans krizi merkez bankacığı uygulamalarında bir dönüm noktası olmuştur öyle ki; bu dönem 2008 öncesi ve sonrası diye nitelendirilebilir. TCMB'nin yeni para politikası araçlarının etkinliği geleneksel olmayan para politikası uygulamalarının bir örneği olarak ve ayrıca makroihtiyati bir açıdan analiz edilmiştir. Yeni para politikası çerçevesinin aktarım mekanizması yalın bir açık ekonomi DSGE modeli çerçevesinde açıklanmıştır. Politikanın etkinliği ise Bayesçi Yapısal VAR modeli ile test edilmiştir. Sonuçlar yeni para politikası çerçevesinin döviz kurlarındaki oynaklığı azalttığını, cari dengede iyileşme sağladığını ve kredi genişlemesini sınırlandırdığını göstermiştir

Anahtar Kelimeler: Geleneksel Olmayan, Para Politikası, Dinamik Stokastik Genel Denge, Bayesçi Yapısal Vektör Autoregresyon, Zorunlu Karşılıklar, Faiz Koridoru.

To My Family; Ömür, Beren and Korhan

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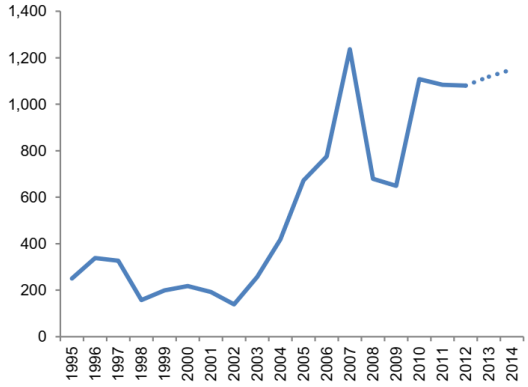
CHAPTER 1: INTRODUCTION

Emerging countries have enjoyed ample capital flows from industrialised countries through financial globalisation and integration of financial systems around the world since the 1980s so much that the international financial integration was regarded as a touchstone in the development of emerging countries (Obstfeld, 2004). With deepening financial linkages, capital flows to emerging countries have increased even more during the last two decades. However, financial globalisation is not a rose without the prick. Research documents that financial integration increased the volatility of capital flows to emerging economies and the vulnerability of small open economies to financial crises (Grosse, 2004; Martin and Rey, 2006; Lane, 2013). The Mexican crisis in 1994, the Asian Crisis in 1997, the Russian Crisis in 1998, the Argentine crisis in 2001 and the Turkish crises in 1994 and 2001 are among the notable financial crises resulting from volatile capital flows (Mishkin, 1999; 2001). It would not be an overstatement to assert that financial crises in emerging countries resulting from volatile capital flows are rampant in the history of financial globalisation (Mendoza, 2006).

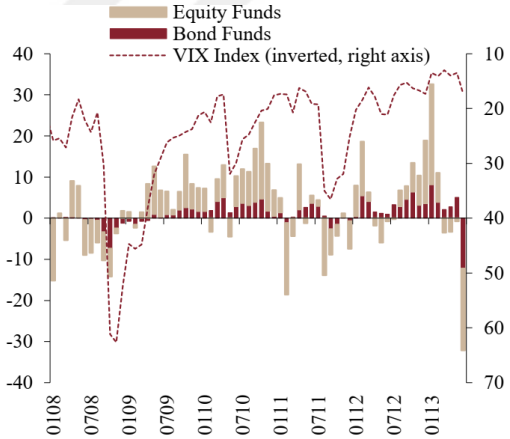
After the first implementation in New Zealand in 1990 and its proved success, the flexible inflation targeting strategy was followed by other emerging economies as well and became a monetary policy rule of thumb for the central banks. 1990s and the beginning of 2000s became an era of disinflation and steady growth rates not only for those emerging countries but also for the global economy. Nonetheless, the outlook of a reasonably long term of stability created new challenges, especially in terms of financial flows to emerging countries. Capital flows to emerging countries raised from USD 139bn in 2002 to USD 1.237bn in 2007 (Figure 1). However, this trend became reversed and capital flows to emerging countries dropped sharply with the global financial crisis in 2008. The recovery was not as easy as expected, especially for advanced countries, and a set of unconventional policies were on the scene. Following the crisis, advanced countries took unforeseen steps in order to boost the economy, such as reducing the overnight policy rate to historically low levels or tolerating large budget deficits, called as quantitative easing policies (Aysan, Fendoğlu and Kılınç, 2014).

The weak recovery of advanced countries and the volatility in external financial flows exposed the emerging countries, on the other side, to the risk of expanded business cycles and the sudden stop of capital flows. Concerns about the advanced countries urged the capital flows from advanced countries to the emerging countries, but these flows were largely short term and more volatile compared to the pre-crises period (Figure 2). These conditions were a big threat to macroeconomic and financial stability in emerging economies. Hence, emerging countries needed to change their traditional economic policy frameworks for more flexible and rich-in-tools policies, which enabled them to response to the adverse consequences of excessive volatility efficiently and on time.



Source: IIF.

Figure 1. Private Capital Flows to Emerging Countries (Billion US Dollar) (Source: Aysan, Fendoğlu and Kılınç, 2014)



Source: EPFR, Bloomberg.

Figure 2. Capital Flows to Emerging Countries (Billion US Dollar) (Source: Aysan, Fendoğlu and Kılınç, 2014)

The world economy experienced financial crises almost periodically in recent decades but the global financial crisis of 2008 exhibits a turning point in the central banking practises of both advanced and emerging countries in the sense that large and volatile capital flows damaged the developing economies. In order to promote spending, pioneered mainly by the Fed and the ECB, the policy rate was lowered almost to zero and the balance sheet size of central banks grew incrementally in advanced economies

as a consequence of quantitative easing (IMF, 2013a; 2013b; 2013c). Capital flows from advanced countries to emerging economies increased substantially, being mostly short-term and volatile in nature, due to the policy uncertainties in advanced countries at the time (Başçı and Kara, 2011).

As the fashion of the moment, the inflation targeting regime was adopted by Turkey as well after 2001 financial crises. At first, Turkey implemented implicit inflation targeting program from 2001 to 2006. Then, in 2006 full-fledged inflation targeting regime was introduced and the main objective of the monetary policy was fixed as achieving and maintaining the price stability. In this regard short-term interest rate was used as the single instrument to keep inflation in line with the target. Even though favorable global economic conditions contributed considerably, inflation targeting period was an economic success story for Turkey. During 2001-2010 annual average inflation rate decreased from 54.2 % to 8.6 % while the average growth rate increased up to 4.1 % (Table 1).

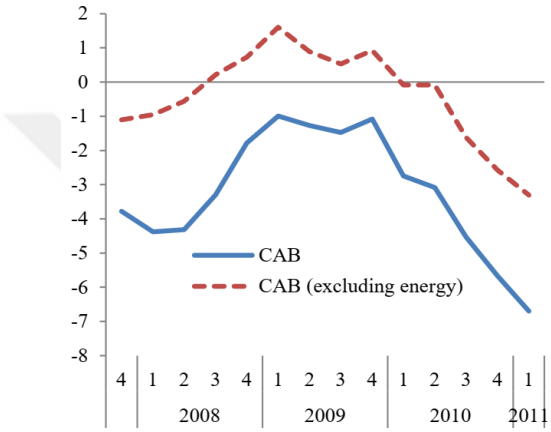
Table 1. Inflation, Output and Current Account (Source: Central Bank of the Republic of Turkey)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Average Inflation (CPI)	54,2	45,1	25,3	8,6	8,2	9,6	8,8	10,4	6,3	8,6	9,9
GDP Growth Rate	-5,7	6,2	5,3	9,4	8,4	6,9	4,7	0,7	-4,8	9	8,5
Current Account/GDP	1,9	-0,3	-2,5	-3,7	-4,6	-6,1	-5,9	-5,7	-2,3	-6,4	-9,9

Although Turkey benefited from huge capital flows in the disinflation period and it helped to achieve remarkable economic growth rates, current account balance eventually deteriorated and the economy became more dependent on the foreign funds. Owing to the structural reforms and domestic demand, Turkish economy showed a quick recovery after a one-year recession in 2009. Excessive capital flows supported domestic credit growth, fueled domestic demand and caused a disproportionate appreciation in the Turkish Lira. Credit growth, together with valued Turkish Lira led to higher demand for imported goods but exports remained low because of the appreciated Turkish Lira and weak foreign demand. Therefore, current account balance worsened, which caused the economy became more exposed to sudden

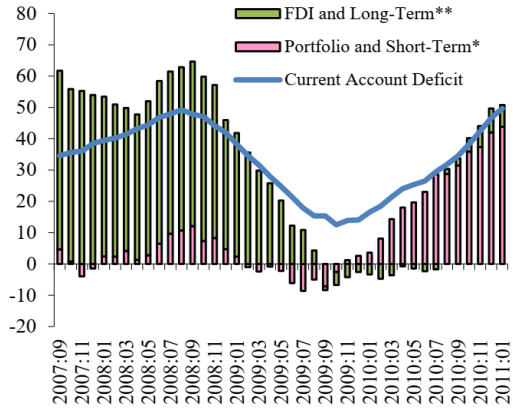
reversals of foreign loans and the output to be more fluctuant. Meanwhile, short term capital and portfolio investments became the main source of increasingly deteriorative current account balance and the concerns about financial stability rose (Kara, 2012).

Figure 3 below shows the rapid deterioration in the current account balance in 2010. Further, Figure 4 reflects that the composition of current account deficit was formed almost entirely by portfolio and short-term funds following 2009.



Source: TURKSTAT, CBRT.

Figure 3. Current Account Balance (Seasonally Adjusted, Quarterly Average, Billion USD) (Source: Aysan, Fendoğlu and Kılınç, 2014)



Source: CBRT.

Figure 4. Main Sources of Current Account Deficit Finance (12-months Cumulative, Billion USD) (Source: Aysan, Fendoğlu and Kılınç, 2014)

As in many emerging market economies, the nominal exchange rates appreciated about 20% and the real exchange rate in Turkey deviated upwards from its long run trend.

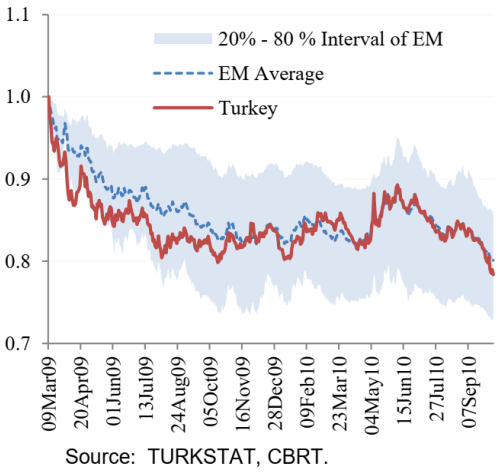


Figure 5. TL and Other EM Currencies Against USD (9 March 2009=1) (Source: Aysan, Fendoğlu and Kılınç, 2014)

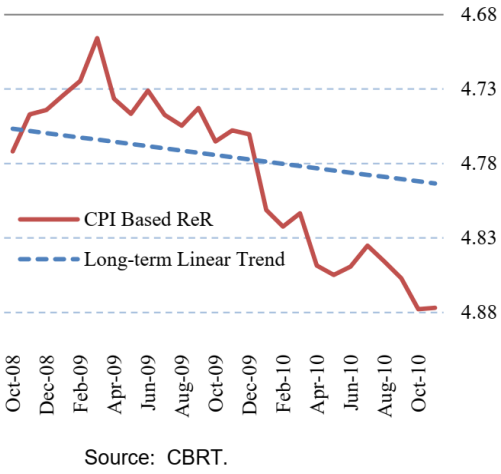


Figure 6. Real Exchange Rates (ReR) in Turkey (2003=100, Logarithmic scale, Reverse order) (Source: Aysan, Fendoğlu and Kılınç, 2014)

Another key variable to track the financial stability is the domestic credit growth. During the surge in foreign flow, which is usually the main source of financing the domestic credit expansion in emerging countries, the risk of a sudden reversal of flows increases and the country faces the risk of a credit and output crush.

After being hit heavily by the crisis and experiencing a 15 percent contraction in 2009, the Turkish economy experienced a dramatic increase in capital flows in the following years, owing to quick economic recovery and strong domestic demand (Kara, 2012). Not surprisingly, the outcome was an expansion in domestic credit, an excessively appreciated currency and a deteriorated current account.

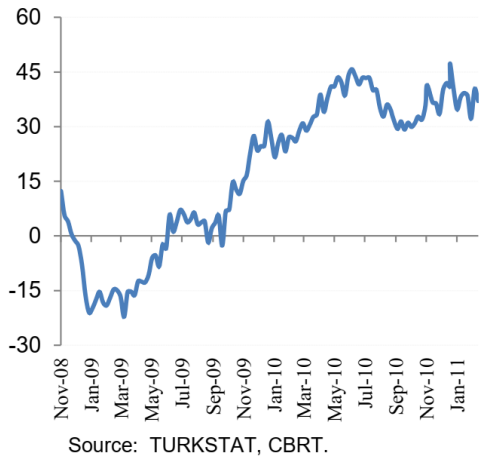


Figure 7. Total Loan Growth Rates (13 Weeks Moving Average, Annualized, FX Adjusted, Percent) (Source: Aysan, Fendoğlu and Kılınç, 2014)

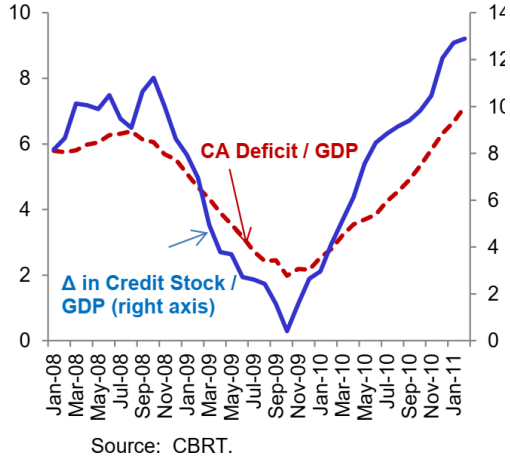


Figure 8. Change in Credit / GDP and CA Deficit / GDP (12 month cumulative, Percent) (Source: Aysan, Fendoğlu and Kılınç, 2014)

Large and volatile capital flows, if not managed accordingly, trigger excessive credit growth and increase the risk of financial instability. Concentrated solely on inflation stabilisation and armed with the conventional interest rate tool, the ordinary response of the central banks by raising the interest rates does not stop the credit boom but rather attracts more capital. As a response, the domestic currency appreciates, the improved balance sheet of borrowers promotes further expansion in credits, the current account balance deteriorates and, in turn, macroeconomic instability worsens (Calvo, 1998; Mendoza and Terrones, 2008; Bruno and Shin, 2013; Bruno and Shin, 2014). In this regard, the reserve requirements made a flash return to the stage as a macroprudential tool in order to tighten credit conditions without attracting more capital, especially in emerging economies, such as Brazil, Croatia, Russia and Turkey (Lim et al., 2011).

Amid increasing macro financial concerns towards the end of 2010, the CBRT announced a change in its policy stance and mentioned the use of alternative policy instruments for the first time. First, it stopped paying remuneration for the required reserves and started to use the reserve requirement ratio actively to contain the risk of credit growth. Later, it designed the Reserve Option Mechanism (ROM) aimed at stabilising the exchange rates (Alper et al., 2012). Second, the CBRT announced the

one-week repo as the main policy instrument for funding, while the overnight borrowing and lending rates functioned as the lower and upper bound of the interest rate corridor (Başçı and Kara, 2011; Kara, 2015). The interest rate corridor was mainly aimed at controlling the short-term speculative capital flows.

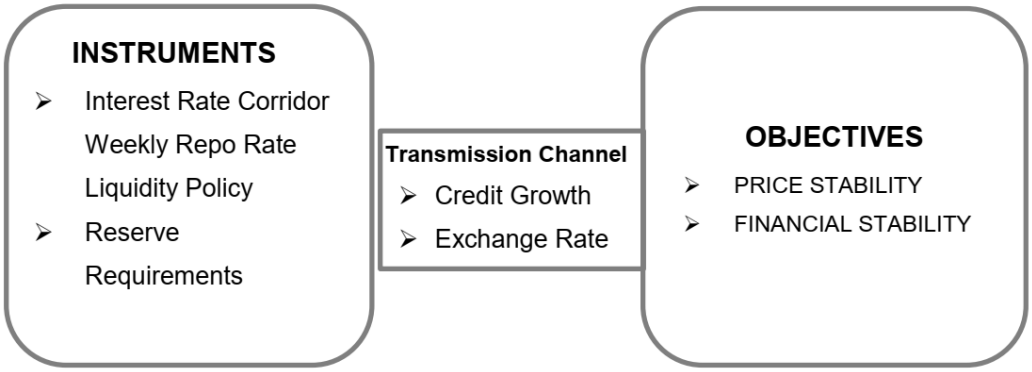


Figure 9. CBRT's Policy Instruments and Objectives (Source: Kara, 2012)

The operational framework of the two new policy tools is summarised below. The ROM allows banks to hold a certain fraction of their Turkish lira reserve requirements in foreign currency or, as implemented later, in gold. During periods of excessive capital inflow, banks can increase their use of ROM and hold foreign currency in place of TL reserve requirements up to a certain threshold. On the other hand, they are allowed to decrease the use of ROM during the capital outflow periods. So, the ROM is a market-friendly mechanism which helps to stabilise the volatility in the exchange rates. The other novel tool, the interest rate corridor, works principally by creating an uncertainty zone between the lending (upper bound) and the borrowing (lower bound) rates of the central banks. Reducing the lower limit of the corridor during the capital inflow periods discourages the foreign capital, while increasing the limit during the capital outflow periods holds its surge. Therefore, the corridor maintains the smoothing of foreign capital flow. The main incentive of the CBRT in employing these additional tools was to increase the resistance of the economy against volatile capital flows, therefore containing the credit growth and maintaining the external balance (Kara, 2012; Oduncu, Akçelik and Ermişoğlu, 2013; Aysan, Fendoğlu and Kılınç, 2014).

The CBRT highlighted two intermediate variables to monitor the level of financial stability: the credit growth and the exchange rate. These variables are also helpful in the communication of the new policy mix. They can easily be monitored and are directly observable by the economic agents. Moreover, they are published in a quite fixed periods of time. These two variables are proved to be the most robust and significant predictors of financial crises by (Gourinchas and Obstfeld, 2012).

Interest Rate Corridor can be defined as the distance between the lending (the ceiling) and the deposit (the floor) rate. The CBRT utilizes the difference of the policy rate to the floor or the ceiling as an additional policy tool. In traditional inflation targeting (price stability) policy the corridor is set symmetrically around the policy rate but here the CBRT can change the upper and lower bound asymmetrically around the policy rate. The CBRT can react to the volatility of short-term capital flows quickly by controlling the uncertainty about the short-term interest return.

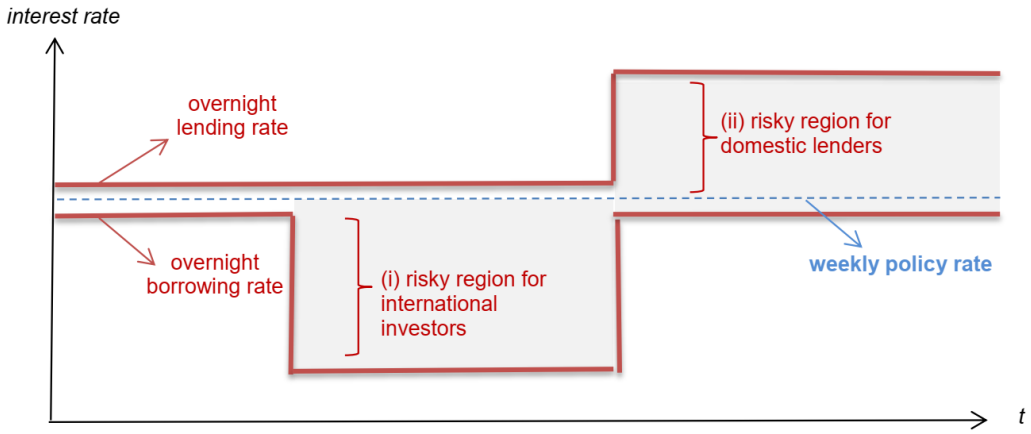
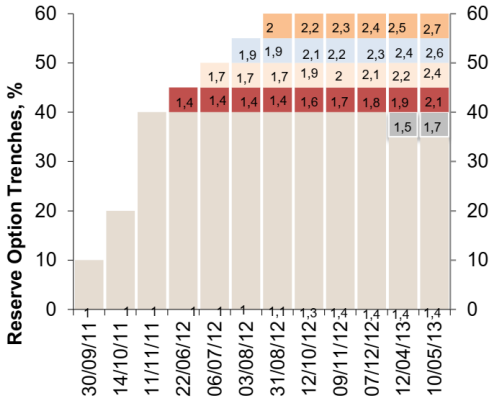


Figure 10. The Interest Rate Corridor and Its Asymmetric Effect on Domestic/Global Lenders (Source: Aysan, Fendoğlu and Kılınç, 2014)

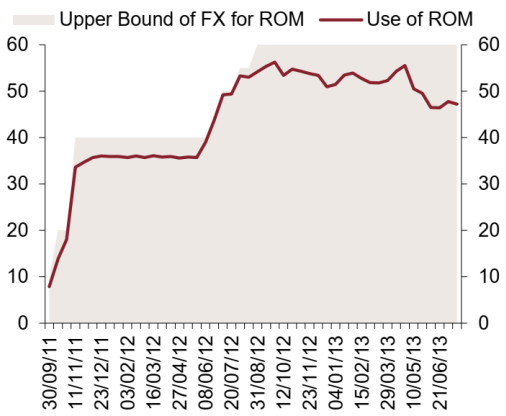
Reserve Option Mechanism (ROM) is designed to control exchange rate fluctuations derived from a surge in the short-term foreign funds. It is a market-friendly tool and reduces the negative effect of capital flows on domestic business cycles. ROM allows banks to keep some of their domestic currency required reserves in foreign currency (FX) or gold. During a surge in capital flows banks can hold their FX at the CBRT and

this FX can be released during capital outflow. So, the CBRT can contain the fluctuations in the exchange rate.



Source: CBRT.

Figure 11. FX Reserve Option Coefficients (Source: Aysan, Fendoğlu, Kılınç, 2014)



Source: CBRT.

Figure 12. ROM Usage Rates (Sour Aysan, Fendoğlu, Kılınç, 2014)

CHAPTER 2: REVIEW OF RELEVANT LITERATURE

The global financial crises proved that the inflation targeting regime itself is not a sufficient condition to maintain the macroeconomic stability. Nevertheless, it was not clear at the very beginning of the crisis if any additional policy target should be adopted and any additional policy tools should be attached into the policy toolkit. Even though the need for a new policy framework has been discussed within international institutions such as the Bank of International Settlement (BIS) and G20, understandably, the academic literature was quite lack of adequate study about the merits of the financial variables in the sense that they convey important knowledge about the signs and appropriate ways of treatment of financial instability.

Eventually, just after seeing its first debris, the crisis and alternative ways of solution to its harmful effects on economies occupied the international political agenda. In addition, academic studies started to emerge as both theoretical and empirical. Papadamou et al. (2020), in this regard, provide a recent review of the literature that burgeoned in this time period.

The matter that the price stability itself cannot guarantee the financial stability was mentioned by several academics such as (Mishkin, 1991) and (Corsetti et al., 1998) well in advance of the crisis. Moreover, Greenspan (2002) confessed that the long period of low interest rate and steady growth rates stimulates the risk appetite and that the authorities might not be able to identify the accumulating risk in the financial system until its bursting confirmed its existence. He almost described the situation and the accumulated risk in the US house market just before 2008. As mentioned in the study of Dell'ariccia, Marquez and Leaven (2010) as well, long period of low interest rates between 2001-2005 had encouraged the US households to borrow more and invest in house market. Nevertheless, following an unexpected rise in interest rates between 2005-2006 lighted the touch paper in the US economy and the boom in the subprime mortgage market was realised only when it burst.

The global financial crisis sparked by the subprime mortgage crisis in the US resulted in quantitative easing (QE) not only in the US but also in many other large economies. Interest rates in those countries approached the Zero Lower Bound (ZLB), which drove the central banks, in both advanced and emerging economies, to consider alternative

monetary policies, most of which are macroprudential measures (Kahou and Lehar, 2017; Mester, 2017).

The quantitative easing policies by advanced economies constitute the first examples and the bulk of the literature. Martin and Milas (2012) provides an early discussion of the quantitative easing policies of the advanced economies. They derive two outcomes; i) large-scale asset purchases reduce government bond rates, especially at the longer end of the yield curve though this effect may be temporary and is small if bond rates are already low, ii) QE appears to have been effective in late 2008 and 2009, preventing even larger declines in output and inflation than were experienced. They also note that the very first studies rely on similar methodologies and mostly implemented by central banks.

The spill-over effects on emerging countries have also received significant attention as many emerging economies experienced financial instability due to large and volatile capital flows as a direct consequence of QE in advanced economies. Bhattarai et al., (2021) show that QE policies have increased capital flows to emerging countries and especially to the Fragile Five group which Turkey belongs to. They use Bayesian panel VAR and find that an expansionary US QE shock has significant effects on financial variables in EMEs. Their findings also prove that the QE leads to an exchange rate appreciation, a reduction in long-term bond yields, a stock market boom, and an increase in capital inflows to these countries.

In another study on emerging market economies, Belke and Fahrholz (2018) examines whether and to what extend the non-standard monetary policies of major-currency economies affected the central banking practice in emerging economies. They conclude that the global liquidity from major central banks created “unbalanced” real exchange rate dynamics and volatilities in key prices have the potency of creating financial instability in the emerging economies. In a recent review of literature Bartkiewicz (2018) investigates the spill-over effects on QE policies on emerging economies. The study reveals that the QE policies of advanced economies raises output and inflation in emerging economies while lowering bond yields, raising equity prices and increasing net equity flows.

In general, academic literature is divided into two parts in their suggested responses to

the financial crises; “leaning against the wind” and “cleaning after the burst”. White, (2009) states that monetary policy may ignore the risk stemmed from accumulated debt stock in the medium term while concentrating only on the solutions to the problems of insufficient demand. Therefore, the study concludes that the monetary policy should focus on “pre-emptive tightening” to moderate credit bubbles instead of “pre-emptive easing” to deal with the after effects and suggests a new macro-financial stability framework. The new framework must contain both regulatory and monetary instruments to prevent credit bubbles and so support sustainable growth in the long run.

Even before the financial crisis of 2008, Borio and Shim (2007) asserted that the possibility of financial imbalances in the form of credit and asset price booms increases in a low and stable inflation period which has been experienced over the last decades. They point out the need of a revision in the monetary policy that it should be designed as leaning against the build-up of financial imbalances. Moreover, the prudential policy must also strengthen its macroprudential orientation to make the financial system be able to withstand the unwinding accumulating risks in the system. They also assert that analytical, institutional and political framework for understanding the financial stress in advance must be further improved to form a solid “leaning mechanism”.

The proponents of “cleaning after the burst” have their roots on the so called “Greenspan Doctrine”. It states that the role of the asset prices in conduct of monetary policy must be beyond its estimable effects on inflation and employment, and monetary policy should not lean against the wind. Mishkin (2010), one of the advocates of this approach, listed justification of the “cleaning after the burst” as; i) bubbles are difficult to detect, ii) raising interest rates may not be effective in constraining the bubble, iii) monetary policy affect asset prices in general rather than focusing on defective assets, iv) raising interest rates may increase the damage to the whole economy, v) The authorities have necessary tools so the harmful effects of a burst can be hold in control as long as the authorities respond in timely manner.

Gambacorta and Signoretti, (2014) formulates the “leaning against the wind” approach with the help of a Taylor Rule augmented with asset prices and credit. They analyse if including these variables in the monetary policy rule stabilizes the economy and

improves the welfare of the agents. Their results are instructive especially for the emerging countries which are usually subject to excessive credit growth fuelled by foreign capital influx. They show that central banks' response to financial variables, such as asset prices and credit stock, can improve the welfare and LATW approach may bring about gains as high as 20-30%.

Monetary or macro-prudential policies are found to be more effective when they lean against the credit cycles in the analysis of Lambertini, Mendicino and Punzi (2013). They use a countercyclical LTV rule as a macro-prudential tool and an interest rate rule (directly responds to credit growth) as the monetary policy tool. Both rules are compared to each other according to their effectiveness in curbing volatility in credits and improving welfare. They conclude that both instruments are successful in reducing volatility in credit cycles without increasing the volatility in inflation. Moreover, using these tools in a LATW approach is found to be Pareto improving comparing to the benchmark policy.

When the interest rate rule is determined narrowly to focus just on the inflation, the resulting posture of the inflation gives rise to stock market booms and credit growth. In their medium-sized DSGE model Christiano et al. (2010) claims that inflation falls and the output rises when there is an optimistic approach to the future of the economy.

The boom at this point is found to be a by-product of an empirically estimated interest rate rule in which the inflation forecast has the highest coefficient. On the other hand, historical data proves that assigning an additional role, such as credit growth, in addition to the inflation forecast helps in stabilizing the boom. The "leaning-against-the-wind" role of the new policy rule, here, mitigates an overdosed response of the inflation rate to the boom.

After the financial crisis Turkey was one of the recipients of large capital inflows and responded by initiating a new monetary policy framework utilising macroprudential instruments. The CBRT started to employ macroprudential instruments in the last quarter of 2010 when the aftershock of the financial crisis started to come ashore in Turkey. The monetary policy framework modified and financial stability was attached to the objective function. The CBRT adopted its interest rate rule, similar to the "leaning-against-the-wind" approach, in order to respond to variations in the credit

growth and trade balance but also engaged two new instruments (Reserve Option Mechanism and Asymmetric Interest Rate Corridor) to maintain the financial stability objective together with the price stability.

Following an intense implementation of this multi-tooled monetary policy, as the global economic outlook started to normalise, the CBRT announced its roadmap to simplify the monetary policy implementation in August 2015. The main incentive of this simplification was to form a more predictable monetary policy to improve the expectations of the economic agents. As of May 2018, the CBRT completed the simplification period and the interest rate corridor was abolished. Moreover, the active use of the ROM has been diminished gradually, and the CBRT declared that it will end its usage in 2022.

Aysan et al. (2012) and Başçı and Kara (2011) are the very first studies to evaluate the results of the implementation of the new policy framework numerically. They acknowledge that Turkey need a flexible monetary policy framework to cope with the harmful effects of volatility in capital flows. Throughout the recent history of Turkey, volatility in capital flows has been an important factor for macroeconomic stability. So, they reaffirm the need for enhancing the resilience of the economy against abrupt changes in the global risk appetite even though there may not be a causal relationship between capital flows and financial instability in Turkey. The very first results in their analysis proves that the credit growth was contained and trade deficit was controlled.

In another earlier study, Kara (2012) explains the transmission mechanism of the new policy framework in detail and comments on the first results. He clearly explains the need for additional policy tools in the case of a monetary policy with multiple objectives, from the point of the trade-off that may arise between financial stability and price stability if there is a single policy tool. The study agrees that the new policy framework proved to be efficient in curbing the harmful effects of the capital flows and managing a soft landing of the economy without a conflict with the price stability objective.

Eventually, the first empirical studies of Turkish experience with the “multiple objective, multiple tool” policy started to emerge. Aysan et al. (2014) showed that after controlling for a set of domestic and external variables and relative to a group of

advanced and emerging countries, cross-border capital flows to Turkey have been less sensitive to global factors after the implementation of macroprudential policies. They used a panel data set of 46 countries and measured the effectiveness of Turkey's new policy as a comparison to other emerging countries which had experienced a similar pattern of global capital flow.

Oduncu, Akçelik, and Ermişoğlu (2013) examined the effect of ROM on the volatility of Turkish Lira with GARCH method. They used the daily change in a currency basket formed as (%50 EUR+%50 USD) and observed between October 2010-2012. Their findings suggest that the ROM has decreased the (conditional) volatility of USD/TL exchange rate significantly, controlling for international risk appetite and the CBRT's other policy actions.

Controlling for common external factors, Değerli and Fendoğlu (2013a) provide "descriptive evidence" that the ROM is successful in containing the (implied) volatility, skewness and the kurtosis of USD/TL exchange rate expectations. More noticeably, ROM appears to be helpful in containing the expected USD/TL volatility and kurtosis.

In their other study Değerli and Fendoğlu (2013b) study empirically (i) whether the use of ROM makes the volatility, skewness, or kurtosis of USD/TL expectations lower relative to other emerging market currencies (ii) whether the USD/TL exchange rate expectations become less sensitive to fluctuations in common external factors due to the ROM. Estimating a common external factor for each moment (volatility, skewness, or kurtosis), using a large set of emerging market currencies, and controlling for such common external factors and other policy actions by the CBRT, the results suggest that after the implementation of the ROM, market expectations are leaned towards a significantly lower volatility or skewness in the USD/TL relative to other emerging market exchange rates; and ROM appears to be an automatic stabilizer of expectations about excessive movements of the USD/TL exchange rate.

In a recent empirical study, not privately for Turkey but for 18 emerging countries including Turkiye, Fendoğlu (2017) evaluated the effectiveness of macro-prudential policy tools in containing credit cycles. He employed a wide range of macro-prudential policy measures so classifies them into two groups (i) borrower-related measures (caps

on loan-to-value ratio and caps on debt-to-income ratio) (ii) financial-institutions-related measures (counter-cyclical capital requirements, dynamic loan-loss provisioning, restrictions on foreign currency lending, and limits on net open currency position). The results show that borrower-based tools, measures with a domestic focus, and domestic reserve requirements are particularly effective. His findings are, in most cases, stronger for the recent period during which most of the macro-prudential actions are undertaken, and holds for alternative definitions of credit cycle, the monetary policy stance, and portfolio inflows.

The study by Erdem et al. (2017) focuses on the effects of macro-prudential policies on credit growth. Including Turkiye as well, they employ data from 30 countries and indicates that macroprudential policies are effective to limit domestic credit growth especially during expansion phase of the credit cycles. An interesting finding is that, the number of policy tools is crucial to better manage the domestic credit growth in the way that they help preventing the players of financial system from bypassing the regulations, so limits the possibility of leakages in the financial system.

Another facet of literature on Turkish experience focuses on a single policy tool rather than the framework in general. Binici et al. (2013) provides empirical evidence with respect to the use of interest rate corridor as a macro-prudential tool affecting the loan-deposit spread, and hence credit supply. Using both time series and cross section data, they analyze the effect of interest rate corridor on loan and deposit rates as well as their spread. The empirical results they found indicate that, the use of interest rate corridor jointly with active liquidity policy enables the CBRT to affect the loan-deposit spread. In other words, asymmetric interest rate corridor has the potential to be used as a macro-prudential policy instrument.

CHAPTER 3: AN OPEN ECONOMY MACROECONOMICS DSGE MODEL

This chapter introduces an open economy dynamic stochastic general equilibrium model of the Turkish economy. The main objective is to enlight the transmission mechanism of the macro-prudential tools adopted by the central bank. The model is constructed in a simple and compact way so that makes it easy to follow the relations between the policy tools and the macroeconomic variables. The micro-foundations of the model is broadly in line with (Gali and Monacelli, 2005). The financial sector and the monetary policy are inspired from (Glocker and Towbin , 2012; Unsal, 2011; Çufadar, 2012).

The model's dynamics are improved by incorporating nominal price rigidity and indexation into the model. Moreover, it is augmented by featuring structural shocks such as country risk premium, technology etc. The foreign economy is modelled as exogenous and the domestic economy further includes households, domestic firms, importers, exporters, commercial banks and central bank.

3.1. Main Characteristics of the Model

3.1.1. Households

The representative households are assumed to be identical. They consume the final goods, supply labour and hold only domestic currency deposits. They are allowed to save only through the banking system so they provide funding to the banks. They dont engage in any foreign currency transactions.

The representative household maximizes the following utility function:

$$U(C_t, N_t) = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right) \qquad (1)$$

N_t represents hours of labour

C_t represents composite consumption index

σ is the coefficient of the relative risk aversion of the households (the inverse of the inter-temporal elasticity of substitution in consumption).

φ is the inverse elasticity of the labour with respect to the wage

$0 < \beta^t < 1$ is the discount factor[1].

In this small open economy, household consume both domestic and foreign goods. Therefore the consumption is defined as a composite index of foreign and domestic goods, C_t :

$$C_t = \left[(1-\alpha)^{1/\eta}(C_{H,t})^{\left(\frac{\eta-1}{\eta}\right)} + \alpha^{1/\eta}(C_{M,t})^{\left(\frac{\eta-1}{\eta}\right)}\right]^{\frac{\eta}{\eta-1}} \quad (2)$$

where;

$\eta > 1$ is the substitutability between domestic and foreign goods and $\alpha \in [0,1]$ is the home bias in preferences (a degree of openness, or ratio of imports).

$C_{H,t}$ and $C_{M,t}$ are the indices of domestically produced and imported goods respectively and are represented by a CES function of the form:

$$C_{H,t} = \left(\int_0^1 C_{H,t}(j)^{\left(\frac{\varepsilon-1}{\varepsilon}\right)} dj\right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (3)$$

is the aggregate index of domestically produced goods and

$$C_{M,t} = \left(\int_0^1 C_{M,t}(j)^{\left(\frac{\varepsilon-1}{\varepsilon}\right)} dj\right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (4)$$

is the aggregate index of foreign goods, where

$$C_{M,t}(j) = \left(\int_0^1 C_{Mi,t}(j)^{\left(\frac{\varepsilon-1}{\varepsilon}\right)} dj\right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (5)$$

[1] Through out the study small case letters symbolize the log-linear form of that variable. The steady state is indicated with a subscript as x_{ss}. A hat over the variable represents the log-deviation from steady state and E is the expectations operator.

$C_{Mi,t}(j)$ represents the j-th good produced in the i-th country, and $\varepsilon > 1$ is the elasticity of substitution between different types of goods in domestic country.

The households are constrained by a budget equation. The discounted value of the expected utility is maximized under the conditions of this budget constraint. Income from the labour supply as wage payents, previous period's interest earnings from deposits and dividents from the firms are used in order to compenste present consumption and portfolio. Therefore the households' flow of budget constraint can be written as below:

$$P_t C_t + D_t = W_t N_t + i_{t-1}^D D_{t-1} + Div_t \tag{6}$$

W_t is the nominal wage.

Div_t is the nominal dividend from domestic and foreign goods retail firms

D_t is the domestic currency deposits

P_t is the domestic price level

i_t^D is the gross domestic currency deposit rate

There is no cash in the economy.

The household maximizes the utility function subject to the budget constraint. Therefore the Lagrange equation for this optimization can be written as follows

$$\begin{aligned} &L_t(C_t, N_t, D_t, \lambda_t) \\ &\qquad = U(C_t, N_t) + \lambda_t[P_t C_t + D_t - W_t N_t - i_{t-1}^D D_{t-1} - Div_t] \end{aligned} \tag{7}$$

First order conditions of the households' utility maximization problem with respect to the consumption, labour, and deposits yield the following equations:

$$(\partial C_t) \qquad \lambda_t = \beta^t C_t^{-\sigma} \tag{8}$$

$$(\partial N_t) \qquad \lambda_t \frac{W_t}{P_t} = \beta^t N_t^{\varphi} \tag{9}$$

$$(\partial D_t) \qquad \lambda_t \frac{1}{P_t} = E_t\, \lambda_{t+1} \frac{i_t^D}{P_{t+1}} \tag{10}$$

Solving (7) and (9) together gives us the standard Euler Equation of the form:

$$\beta E_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \right] i_t^D = 1 \tag{11}$$

Log-linearize the Euler equation around the steady-state:

$$\hat{c}_t = E_t \hat{c}_{t+1} - \frac{1}{\sigma} (\hat{\imath}_t^D - E_t \hat{\pi}_{t+1}) \tag{12}$$

where $\Pi = \frac{P_t}{P_{t+1}}$ is the gross domestic inflation.

Assuming the complete flexibility of the wages and the households' optimization, the labour supply equation can be derived by solving (7) and (8):

$$N_t^{\varphi} = \frac{1}{C^{\sigma}} w_t \tag{13}$$

where

$$w_t = \frac{W_t}{P_t} \tag{14}$$

is the real wage. And the log-linear representation will be:

$$\hat{n}_t = \frac{1}{\varphi} (\hat{w}_t - \sigma \hat{c}_t) \tag{15}$$

The households' total expenditure can be written as:

$$P_{H,t} C_{H,t} + P_{M,t} C_{M,t} = P_t C_t \tag{16}$$

where

$$P_{H,t} = \left(\int_0^1 P_{H,t}(j)^{(1-\varepsilon)}\, dj \right)^{\frac{1}{1-\varepsilon}} \quad and \;\; P_{M,t} = \left(\int_0^1 P_{M,t}(j)^{(1-\varepsilon)}\, dj \right)^{\frac{1}{1-\varepsilon}} \tag{17}$$

are the price indices for domestic and import goods respectively in domestic currency. And,

$$P_{M,t}(j) = \left(\int_0^1 P_{Mi,t}(j)^{(1-\varepsilon)}\, dj \right)^{\frac{1}{1-\varepsilon}} \tag{18}$$

where $P_{Mi,t}(j)$ represents the price of *j-th* good imported from the *i-th* country in domestic currency.

The maximization of the composite consumption function (2) subject to the expenditure function (17) (optimal allocation of the total expenditure between domestic and foreign goods) gives the first order conditions:

$$\left(\partial C_{H,t}\right) \quad \lambda_t P_{H,t} = \frac{\eta}{\eta-1}\left((1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{M,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{1}{\eta-1}} (1 - \alpha)^{\frac{1}{\eta}} \frac{\eta-1}{\eta} C_{H,t}^{-\frac{1}{\eta}} \tag{19}$$

$$\left(\partial C_{M,t}\right) \quad \lambda_t P_{F,t} = \frac{\eta}{\eta-1}\left((1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{M,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{1}{\eta-1}} (\alpha)^{\frac{1}{\eta}} \frac{\eta-1}{\eta} C_{M,t}^{-\frac{1}{\eta}} \tag{20}$$

Solving the first order conditions bears three important equations regarding with the allocation of expenditures.

$$C_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t \tag{21}$$

gives the demand function for domestic goods and

$$C_{M,t} = \alpha \left(\frac{P_{M,t}}{P_t}\right)^{-\eta} C_t \tag{22}$$

gives the demand function for foreign goods. Here,

$$P_t = \left[(1-\alpha)(P_{H,t})^{1-\eta} + \alpha (P_{M,t})^{1-\eta} \right]^{\frac{1}{1-\eta}} \tag{23}$$

represents the consumer price index (CPI).

Log-linearize the consumer price index around the steady state, we get

$$\hat{p}_t = (1-\alpha)\hat{p}_{H,t} + (\alpha)\hat{p}_{M,t} \tag{24}$$

And the first difference of this equation yields a representation of the consumer price index as the weighted sum of domestic and imported goods inflation.

$$\hat{\pi}_t = (1-\alpha)\hat{\pi}_{H,t} + (\alpha)\hat{\pi}_{M,t} \tag{25}$$

Define the relative price of the home goods to the total consumer prices as $\gamma_{h,t} = \frac{P_{H,t}}{P_t}$. After log-linearizing and taking the first difference; we get an expression for the relative prices - inflation relationship which will help us in explaining the model dynamics.

$$\hat{\gamma}_{H,t} = \hat{\gamma}_{H,t-1} + \hat{\pi}_{H,t} + \hat{\pi}_t \tag{26}$$

3.1.2. Terms of Trade, The Real Exchange Rate and The Inflation

The ratio of the aggregate import prices to the export prices is called as the terms of trade. It shows the required amount of home goods to be able to import one unit of foreign goods and so conveys valuable information about the competitiveness of domestic goods in foreign markets. Any increase in the price level of the foreign economy or a decrease in domestic price level will increase the terms of trade and improve the competitiveness of the domestic economy. In line with Gali and Monacelli (2005) the terms of trade is written as;

$$S_t = \frac{P_{M,t}}{P_{H,t}} \tag{27}$$

or, in log-linear form:

$$\hat{s}_t = \hat{p}_{M,t} - \hat{p}_{H,t} \tag{28}$$

Combining this representation of terms of trade with the log-linear representation of the CPI (24) we get;

$$\hat{p}_t = (1-\alpha)\hat{p}_{H,t} + (\alpha)\hat{p}_{M,t} \quad (29)$$

$$\hat{p}_t = \hat{p}_{H,t} + (\alpha)\hat{s}_t \quad (30)$$

The first difference of this equation will give us an important representation of the relationship between the CPI inflation, domestic inflation and the change in terms of trade:

$$\hat{\pi}_t = \hat{\pi}_{H,t} + (\alpha)\Delta\hat{s}_t \quad (31)$$

in another way;

$$\Delta\hat{s}_t = \hat{\pi}_{M,t} - \hat{\pi}_{H,t} \quad (32)$$

Accordingly, we can state that the difference between overall and domestic inflation is proportional to the change in the terms of trade and as the the degree of openness (α) increased, the required change in terms of trade (Δs_t) will be smaller. Or, from the second representation, the change in terms of trade is proportional to the difference between the foreign and domestic inflation.

Define $\mathcal{E}_t$ as the bilateral nominal exchange rate (the foreign currency level in terms of domestic currency) such that an increase of $\mathcal{E}_t$ implies the depreciation of domestic currency. The real exchange rate;

$$Q_t = \frac{\mathcal{E}_t P_t^*}{P_t} \quad (33)$$

shows the ratio of home and foreign country's CPI levels in domestic currency.

We assume that the law of one price holds for both import and export prices in all individual goods.

$$\Psi_t = \frac{\mathcal{E}_t P_t^*}{P_{M,t}} \quad (34)$$

The law of one price holds when ($i.e. \Psi_t = 1$) the price of imports equals the foreign price index in domestic currency; $P_{M,t} = \mathcal{E}_t P_t^*$. Log-linearizing this expression yields;

$$\hat{p}_{M,t} = \hat{e}_t + \hat{p}_t^* \quad (35)$$

Where, e_t is the log nominal effective exchange rate and p_t^* is the log nominal world price index. Combining this equation with the equation for the terms of trade we get;

$$\hat{s}_t = \hat{e}_t + \hat{p}_t^* - \hat{p}_{H,t} \quad (36)$$

Next, we can derive an equation which relates the real exchange rate to the terms of trade by first expressing real exchange rate in log-linear form and then by combining the real exchange rate with (35) and (36);

$$\hat{q}_t = \hat{e}_t + \hat{p}_t^* - \hat{p}_t \quad (37)$$

$$\hat{q}_t = \hat{s}_t + \hat{p}_{H,t} - \hat{p}_t \quad (38)$$

$$\hat{q}_t = (1 - \alpha)\hat{s}_t \quad (39)$$

An increase in the real exchange rate will appreciate the import prices and will in turn increase the terms of trade. Nevertheless this effect is inversely related to the openness of the home economy.

3.1.3. International Risk Sharing and Uncovered Interest Parity Condition

The assumption of complete international financial markets and perfect capital mobility generates two important relationship. The first one is figured out by the international risk sharing which states that the price of similar assests must be the same in the domestic and foreign markets. The definition of the same assets, here, refers to the similarity in liquidity and risk. We can formulate the international risk sharing as;

$$1 + i_t^D = (1 + i_t^*)E_t(\frac{\mathcal{E}_t}{\mathcal{E}_{t+1}}) \quad (40)$$

which states that the return of nominal domestic interest rate must be the same as the return of nominal foreign interest rate in domestic currency. Since we include a country risk premium in our model for commercial banks' foreign funding cost, we need to modify the international risk sharing as;

$$1 + i_t^D = (1 + \Phi_t^{CRP})(1 + i_t^*)E_t(\frac{\mathcal{E}_t}{\mathcal{E}_{t+1}}) \quad (41)$$

The second important relationship emerging from the assumption of the complete international financial markets is the uncovered interest parity condition (UIP). Log-linearizing the equation (41) around steady-state we get the UIP condition for the nominal exchange rate:

$$\hat{\imath}_t^* - \hat{\imath}_t^D = E_t \Delta \hat{e}_{t+1} + \Phi_t^{CRP} \tag{42}$$

using this condition we can further formulate a relationship between the real exchange rate and the real interest rate differentials.

$$E_t \Delta \hat{q}_{t+1} = (\hat{\imath}_t^* - E_t \hat{\pi}_{t+1}^*) \; - \; (\hat{\imath}_t^D - E_t \hat{\pi}_{t+1}) - \Phi_t^{CRP} \tag{43}$$

which restates the condition that the net of real interest rate differential in favour of foreign real interest rate will increase the real exchange rate.

3.1.4. Commercial Banks

In order to improve the tractability of the model we build a modified version of a simple banking system of Unsal (2011), Kannan, Rabanal and Scott (2009) and Çufadar (2012). In this context, banks collect deposits from households and obtain funds from international markets. They operate in a competitive financial market. The supply of loans is extended only to the domestic firms. At the end of each period banks pay the deposits to the households and the foreign funds to the international lenders with their accumulated interest payments. There is no excess funds and zero profit condition prevails.

The construction method of the banking system makes the model build on a generic form of macro-prudential measures instead of analysing and solving the model for each macro-prudential policy instrument. The macro-prudential policy variables here include all types of costs in this regard, such as reserve requirements, capital requirements, capital controls, loan-to-value ceiling etc. The macro-prudential tools increase the funding cost of the banking system both in domestic and foreign markets, and then the cost is reflected to the borrowers as higher interest rates.

The country risk premium is another factor of higher funding costs for the banking sector and arise from imperfect integration with the rest of the world. The country risk

premium, such as the one as given in the equation (50), increases with the level of indebtedness and indicates the risk of a default of the domestic economy, which, in the end, causes higher interest rates to be compensated by the economic agents in the country. In other words, the banking system bears additional funding rate cost depending on the level of the domestic country's risk premium and reflects this additional cost to the borrowers as higher lending rates.

We assume that the deposit rate is equal to the central bank's policy rate. Accordingly, the lending rate for the domestic currency credits can be written as;

$$i_t^D = i_t^{CB} \tag{44}$$

$$i_t^{LD} = i_t^D \Phi_t^{MP} \tag{45}$$

and in log-linear form:

$$\hat{\imath}_t^D = \hat{\imath}_t^{CB} \tag{46}$$

$$\hat{\imath}_t^{LD} = \hat{\imath}_t^{CB} + \hat{\Phi}_t^{MP} \tag{47}$$

where $\hat{\Phi}_t^{MP}$ is a macro-prudential mark-up which reflects the spread over the deposit rates caused by macro-prudential policy tools for the domestic currency transactions, such as the reserve requirements.

The lending rate for the foreign funds can be written as;

$$i_t^{LF} = i_t^* \Phi_t^{CRP} \Phi_t^{MP,X} \tag{48}$$

$$\hat{\imath}_t^{LF} = \hat{\imath}_t^* + \hat{\Phi}_t^{CRP} + \hat{\Phi}_t^{MP,X} \tag{49}$$

where, $\hat{\Phi}_t^{MP,X}$ is a macro-prudential mark-up over foreign borrowing rates and includes the policy measures such as the interest rate corridor, reserve option mechanism or kind of any capital control rules. Φ_t^{CRP} is, on the other hand, reflects the country risk premium as stated in Schmitt-Grohe and Uribe, 2003 and defined as;

$$\Phi_t^{CRP} = exp\left[\varphi^{CRP}\left[\frac{\mathcal{E}_t B_t^*}{P_t Y_t}\right] + \varepsilon_t^{CRP}\right] \tag{50}$$

the log-linear form;

$$\widehat{\Phi}_t^{CRP} = \varphi^{CRP}\hat{b}_t^* + \hat{\varepsilon}_t^{CRP} \quad (51)$$

$$\hat{\varepsilon}_t^{CRP} = \rho_t \hat{\varepsilon}_{t-1}^{CRP} + u_t^{CRP} \quad (52)$$

Here, B_t^* is the amount of the foreign borrowing, φ^{CRP} is the elasticity of the risk premium to the external debt level and ε_t^{CRP} is an exogenous element to reflect the global risk appetite, domestic economic or political conditions etc. i_t^* is the foreign interest rate.

3.1.5. Domestic Firms

There is a continuum of monopolistic competitive domestic firms owned by households. They produce differentiated goods by using only labour. We include the working capital mechanism within the model. In working capital mechanism firms need to borrow some constant fraction of their cost from the commercial banks in advance of the production. Here, they borrow total wage cost from commercial banks at borrowing rate r_t, which is a weighted average of both the domestic borrowing rate i_t^{LD} for TL borrowing and at the foreign borrowing rate i_t^{LF} for FX borrowing.

The aggregate production of domestic output is represented by a CES function.

$$Y_t = \left(\int_0^1 Y_t(j)^{\left(\frac{\varepsilon-1}{\varepsilon}\right)} dj \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (53)$$

$\varepsilon > 1$ is the elasticity of substitution between different types of goods.

The production function for a representative firm which produces differentiated domestic good (*j)* with a linear technology is;

$$Y_t(j) = A_t N_t(j) \quad (54)$$

where, $a_t = LogA_t = \rho_a a_{t-1} + \varepsilon_{a,t}$ is the technology progress (productivity shock) following AR(1) for all $t = 1,2,3,\ldots$

The log-linear approximation can be written as:

$$\hat{y}_t = \hat{a}_t + \hat{n}_t \quad (55)$$

The total cost of production in real terms can be written as:

$$TC_t = \frac{W_t}{P_{H,t}} \frac{Y_t}{A_t} (1 + r_t) \tag{56}$$

meaning that the labour cost need to be compensated by working capital, and r_t is the gross borrowing rate.

From (56) the marginal cost can be derived as:

$$MC_t = \frac{W_t}{P_{H,t}} \frac{1}{A_t} (1 + r_t) = (1 + r_t) w_t \frac{1}{A_t} \tag{57}$$

and the log-linear representation will be:

$$\widehat{mc}_t = \hat{w}_t - \hat{a}_t \tag{58}$$

which states that any increase in real wage will increase the marginal cost while an increase in the productivity reduces it.

The firms set their prices in Calvo (1983) style which augments the model by bringing in staggered prices and the rigidities of real life into the model. According to the optimizing decisions of the firms in production process, every period only $(1 - \theta_H)$, where $(0 \leq \theta_H \leq 1)$, fraction of the firms can change the prices. The rest of the firms adjust their prices by backward indexation to the inflation level. Therefore the aggregate domestic price level is defined as:

$$P_{H,t} = \left[(1 - \theta_H) \bar{P}_{H,t}^{1-\rho} + \theta_H \tilde{P}_{H,t}^{1-\rho} \right]^{\frac{1}{1-\rho}} \tag{59}$$

where, $\bar{P}_{H,t}$ is the new price level for the optimizing firms and $\tilde{P}_{H,t}$ is the indexed price level for the rest of the firms.

Backward indexation can be described as:

$$\tilde{P}_{H,t} = P_{H,t-1} \left(\frac{P_{H,t-1}}{P_{H,t-2}} \right) = P_{H,t-1} (1 + \Pi_{H,t-1}) \tag{60}$$

where $(1 + \Pi_{H,t-1}) = \frac{P_{H,t-1}}{P_{H,t-2}}$ and the log-linearize form:

$$\hat{\hat{p}}_{H,t} = \hat{p}_{H,t-1} + \hat{\pi}_{H,t-1} \tag{61}$$

Therefore we can now write the log-linearize form of equation (40) as:

$$\hat{\pi}_{H,t} = (1 - \theta_H)(\hat{\hat{p}}_{H,t} - \hat{p}_{H,t-1}) + \hat{\pi}_{H,t-1} \tag{62}$$

The price setting firms will optimize the price level $\bar{P}_{H,t}$ when they maximize the current value of their future dividends of the form:

$$\mathrm{E_t} \sum_{t=0}^{\infty} \theta_H^k \frac{1}{R_{t+k}} \{Y_{t+k}(j)(\bar{P}_{H,t}(j) - MC_{t+k}^n)\} \tag{63}$$

Subject to the demand function.

$$Y_{H,t+k}(j) = \left(\frac{\bar{P}_{H,t}}{P_{H,t+k}}\right)^{-\varepsilon} (C_{H,t+k} + C_{H,t+k}^*) = \left(\frac{\bar{P}_{H,t}}{P_{H,t+k}}\right)^{-\varepsilon} (Y_{t+k}) \tag{64}$$

where

$$\frac{\theta_H^k}{R_{t+k}}$$

is the effective stochastic discount rate, $\varepsilon > 1$ is the elasticity of substitution between different types of goods in domestic country and

$$MC_t^n = \frac{W_t}{A_t}$$

is the nominal marginal cost.

The first order condition of this optimization of which $\bar{P}_{H,t}$ satisfies will be;

$$\mathrm{E_t} \sum_{t=0}^{\infty} \theta_H^k \frac{1}{R_{t+k}} \left\{ Y_{t+k} \left(\bar{P}_{H,t} - \frac{\varepsilon}{1-\varepsilon} MC_{t+k}^n \right) \right\} = 0 \tag{65}$$

where $\frac{\varepsilon}{1-\varepsilon}$ defines a mark-up over the marginal cost.

The log-linear form of this condition can be written as

$$\hat{\tilde{p}}_{H,t} = \hat{p}_{H,t-1} + E_t \sum_{t=0}^{\infty} \beta^k \theta_H^k \{\pi_{t+k} + (1-\beta\theta_H)\widehat{mc}_{t+k}\} \tag{66}$$

where

$$MC_t = \frac{MC_t^n}{P_{H,t}}$$

So we can write the equation (47) in a more compact way as;

$$\hat{\tilde{p}}_{H,t} = (1-\beta\theta_H) \sum_{t=0}^{\infty} \beta^k \theta_H^k \, E_t \widehat{mc}_{t+k}^n \tag{67}$$

where, $mc_{t+k} = mc_{t+k}^n - p_{H,t+k}$ is the real marginal cost and the compact form of the optimized price function states that the price setting firms set the new price as a mark-up over a weighted average of the expected value of their future marginal costs.

The log-linear approximation of the equation (47) will give us the New Keynesian Philips Curve for the domestic firm:

$$\hat{\pi}_{H,t} = \beta(1-\theta_H)E_t\hat{\pi}_{H,t+1} + \theta_H\hat{\pi}_{H,t-1} + \lambda_H\widehat{mc}_t \tag{68}$$

where,

$$\lambda_H = \frac{(1-\beta\theta_H)(1-\theta_H)}{\theta_H}$$

The NKPC implies that the domestic inflation is not just backward indexed but also forward indexed as well. It is worth to note that when $Q_H = 1$ and the NKPC will be backward-looking, meaning that any of the firms are able to optimize the prices. On the other hand, when Q_H =0 and all the firms set their prices the inflation will represent just only a forward looking behaviour. The marginal cost is always an identifier factor on the inflation level, regardless of the level of price setting behaviour.

3.1.6. Imports

Imports are assumed to be final goods. The import retailers operate in a monopolistic competitive market and in a similar manner to the domestic firms, $(0 \leq \theta_M \leq 1)$ of the importing f irms can not optimize prices while $(1 - \theta_M)$ of the firms can optimize import prices according to;

$$\hat{\tilde{p}}_{M,t} = \hat{p}_{M,t-1} + E_t \sum_{t=0}^{\infty} \beta^k \theta_M^k \left\{ \hat{\pi}_{M,t+k} + (1 - \beta\theta_M) \widehat{mc}_{M,t+k} \right\} \tag{69}$$

The price optimizing behaviour depends on the price level of the previous period and the future inflation in addition to the marginal cost of the importing firms. The marginal cost follows the law of one price and functions a mark-up over the import price. A positive law of one price gap creates a difference between the foreign and the domestic prices of imported goods, which allows foreign prices to penetrate into the domestic aggregate price level.

The log linear approximation will give the NKPC for the importing firms.

$$\hat{\pi}_{M,t} = \beta(1 - \theta_M) E_t \hat{\pi}_{M,t+1} + \theta_M \hat{\pi}_{M,t-1} + \lambda_M \widehat{mc}_{M,t} \tag{70}$$

where

$$\lambda_M = \frac{(1 - \beta\theta_M)(1 - \theta_M)}{\theta_M}$$

and

$$mc_{M,t} = \frac{\mathcal{E}_t P_t^*}{P_{F,t}}$$

which represents the real marginal cost for the imported goods.

The log-linear form will be;

$$\widehat{mc}_{M,t} = \hat{s}_t + \hat{p}_t^* - \hat{p}_{M,t} \tag{71}$$

and first differencing, we get;

$$\widehat{mc}_{M,t} = \widehat{mc}_{M,t-1} + \Delta\hat{s}_t + \hat{\pi}_t^* - \hat{\pi}_{M,t} \tag{72}$$

which states that the imported goods price is affected by an increase in the exchange rate and the foreign inflation rate.

The equation (25) for CPI together with domestic goods inflation (51) and foreign goods inflation (53) builds the dynamics of the small open economy and reflects the presence of the nominal rigidities as a form of sticky prices caused by the firms' price decision behaviour.

The total demand for the imported goods can be written as;

$$M_t = \alpha \left(\frac{P_{M,t}}{P_t}\right)^{-\eta} C_t \tag{73}$$

the log-linear form of the import demand can be written as;

$$\hat{m}_t = -\eta\hat{\gamma}_{M,t} + \hat{c}_t \tag{74}$$

where $\hat{\gamma}_{M,t}$ is the relative price of the imported goods to the price of the consumer goods. The deviation of the relative prices from the steady state level can be written as;

$$\hat{\gamma}_{M,t} = \hat{\gamma}_{M,t-1} + \hat{\pi}_{M,t} - \hat{\pi}_t \tag{75}$$

3.1.7. Exports

The export sector sells the final domestic goods to the households in the foreign economy without a price mark-up. Therefore the marginal cost of the exported goods is equal to the domestic prices. We assume that the gross foreign consumption of home goods is represented by a CES function; so that we can write the export of the domestic economy as;

$$X_t = \left(\frac{P_{X,t}}{P_t^*}\right)^{-\eta^*} C_t^* \tag{76}$$

where η^* denotes the elasticity of substitution between home and foreign goods in the

foreign economy. We can further simplify the model by assuming that;

$$Y_t^* = C_t^* \tag{77}$$

and writing in log-linear form will give us export dynamics:

$$\hat{x}_t = -\eta^* \hat{\gamma}_{X,t} + \hat{y}_t^* \tag{78}$$

The export demand dynamics states that the export increases with the foreign demand while a relative increase in export prices reduces the foreign demand for exported goods.

The exporters is also set the price according to Calvo (1983) style such that $(1 - \theta_x)$ of the exporters adjust their prices while the rest θ_x of them set the prices by backward pricing according the following rule;

$$\tilde{P}_{X,t} = P_{X,t-1}\left(\frac{P_{X,t-1}}{P_{X,t-2}}\right) = P_{X,t-1}(1 + \Pi_{X,t-1}) = P_{X,t-1}(\pi_{X,t-1}) \tag{79}$$

Once again, the maximization of the stream of the future profits according to the export demand, together with the price stickiness results with the following export price inflation represented in the log-linear form:

$$\hat{\pi}_{X,t} = \beta(1 - \theta_X)E_t\hat{\pi}_{X,t+1} + \theta_X\hat{\pi}_{X,t-1} + \lambda_X\widehat{mc}_{X,t} \tag{80}$$

where

$$\lambda_X = \frac{(1 - \beta\theta_X)(1 - \theta_X)}{\theta_X}$$

and

$$mc_{X,t} = \frac{P_{H,t}}{\mathcal{E}_t P_{X,t}}$$

which represents the real marginal cost for the exported goods.

The log-linear form will be;

$$\widehat{mc}_{X,t} = \hat{p}_{H,t} - \hat{e}_t - \hat{p}_{X,t} \tag{81}$$

and first differencing, we get;

$$\widehat{\mathrm{mc}}_{\mathrm{X,t}} = \widehat{\mathrm{mc}}_{\mathrm{X,t-1}} - \Delta\hat{\mathrm{e}}_{\mathrm{t}} + \hat{\pi}_{\mathrm{H,t}} - \hat{\pi}_{\mathrm{X,t}} \tag{82}$$

Denote $\gamma_{X,t}$ the ratio of the export prices to the foreign economy price level;

$$\gamma_{X,t} = \frac{P_{X,t}}{P_t^*} \tag{83}$$

so that, we can write the deviation of the relative export prices from the steady state level as;

$$\hat{\gamma}_{X,t} = \hat{\gamma}_{X,t-1} + \hat{\pi}_{X,t} - \hat{\pi}_t^* \tag{84}$$

3.1.8. The Foreign Economy (The Rest of the World)

The foreign economy in the model is introduced in a simple manner while the main relationships between domestic and foreign economy is not overlooked. It is assumed to be exogenous to the domestic economy. Therefore foreign prices π_t^*, output y_t^* and the interest rate i_t^* are assumed to follow an AR (1) procepp.

$$\pi_t^* = \lambda_{\pi^*}\pi_{t-1}^* + \varepsilon_t^{\pi^*} \tag{85}$$

$$y_t^* = \lambda_{y^*}y_{t-1}^* + \varepsilon_t^{y^*} \tag{86}$$

$$i_t^* = \lambda_{i^*}i_{t-1}^* + \varepsilon_t^{i^*} \tag{87}$$

3.1.9. The Central Bank

The monetary authority aims to effect the macroeconomic variables, such as the inflation level, output, unemployment level etc., through implementing monetary policies by using several monetary policy tools. The effect of the monetary policy tools is transmitted on to the macroeconomic variables through the transmission channels,

such as the interest rate, exchange rate, asset prices, credit growth etc., depending on the specific policy tool selection.

In the traditional inflation targeting regime, the central banks aim to keep the inflation level within a specified corridor or just target a specified point by using the short-term interest rate as the single policy tool. Short term interest rate is used to respond to the volatilities in inflation level and output gap. When the financial stability is incorporated into the monetary policy objectives, the central banks need to be equipped with additional policy tools in order to exclude the probability of an unintended interactions between the policy tools. As a single tool, for instance, an increase in interest rate to contain the inflation will also induce an appreciation in the exchange rate and jeopardize the financial stability objective.

Accordingly, we have designed the monetary policy side of the model such as that the central bank is equipped with three monetary policy tools; an interest rate rule and two macro-prudential policy tools. The policy tools compose the variables which are already observed by the central banks regularly and the central banks have the power to intervene them.

The interest rate tool is designed as a modified version of a regular Taylor (1993) rule and states that the central bank will employ the short-term interest rates in order to contain the volatilities in the inflation rate and the output gap. Although there are studies by Cubas (2012) and Adolfson et.al. (2007) which inserts one or more of any other variables (such as the loan rate, exchange rate etc.) into the scope of the interest rate tool, because of the reasons just aforementioned, we adopt a modified version of Çufadar (2012) and use two additional policy tools other than the interest rate tool. The macro-prudential policy tools, here, react to the volatilities in the exchange rates, loan growth and trade balance in order to maintain the financial stability. They function as a "premium over the funding cost" by increasing the spread between the funding and lending rate of the domestic and foreign currency so that containing the excessive credit growth in line with the financial stability objective.

Accordingly, the model is closed by introducing the monetary policy rules as following;

$$\hat{\imath}_t^{CB} = \psi_i \hat{\imath}_t^{CB} + (1-\psi_i)\left[\psi_\pi \hat{\pi}_t + \psi_y \hat{y}_t\right] \quad (88)$$

$$\widehat{\Phi}_t^{MP} = \psi_{MP} \widehat{\Phi}_t^{CB} + (1-\psi_{MP})\left[\psi_{q,MP} \hat{q}_t + \psi_{l,MP} \hat{l}_t + \psi_{tb,MP} \widehat{tb}_t\right] \quad (89)$$

$$\widehat{\Phi}_t^{MPX} = \psi_{MPX} \widehat{\Phi}_t^{MPX} + (1-\psi_{MPX})\left[\psi_{q,MPX} \hat{q}_t + \psi_{l,MPX} \hat{l}_t + \psi_{tb,MPX} \widehat{tb}_t\right] \quad (90)$$

where $\psi_i, \psi_{MP}, \psi_{MPX}, \ \psi_\pi, \psi_y, \psi_q, \psi_l, \psi_{tb}$ are the interest rate smoothing parameter, the first macro-prudential tool rate smoothing parameter, the second macro-prudential tool rate smoothing parameter, the coefficient of the inflation gap, the coefficient of the output gap, the coefficient of the real exchange rate gap, the coefficient of the loan stock gap, the coefficient of the trade balance gap for the related macro-prudential policy tool respectively.

3.1.10. Domestic and External Market Clearing Conditions

We build a model without government in order to focus on the transmission mechanism of the macro-prudential policies.

The goods market clearing conditions can be expressed as:

$$Y_t = C_{H,t} + C_{M,t} + X_t - M_t \quad (91)$$

Since $C_{M,t} = M_t$ we can write the goods market equation as;

$$Y_t = C_{H,t} + X_t = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t + \left(\frac{P_{X,t}}{P_t^*}\right)^{-\eta^*} Y_t^* \quad (92)$$

The log-linear form of the goods market equilibrium can be represented as;

$$\hat{y}_t = \frac{1}{(1+\alpha+tb_{ss})}\left[\frac{C_{T,ss}}{Y_{ss}} \hat{c}_{T,ss} + \frac{X_{ss}}{Y_{ss}} \hat{x}_t\right] \quad (93)$$

where

$$C_{T,ss} = C_{H,ss} + C_{M,ss} = C_{H,ss} + M_{ss} \quad (94)$$

and,

$$tb_{ss} = \left[\frac{X_{ss}}{Y_{ss}} - \frac{M_{ss}}{Y_{ss}}\right] \tag{95}$$

Meaning that, the goods markets clear when the domestic output is equal to the sum of domestic consumption of home goods and imported goods and the foreign consumption of home goods, where;

$$C_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t \tag{96}$$

and,

$$\mathrm{X_t} = C^*_{H,t} = (\alpha)\left(\frac{\mathcal{E}_t P_{H,t}}{P^*_t}\right)^{-\eta} C^*_t \tag{97}$$

From (96), the amount of the domestic goods consumption depends on the amount of the total consumption, degree of the openness, the elasticity of the substitution between home and foreign goods, and the relative price of the home goods to the aggregate domestic price level.

And from (97), the amount of the foreign demand for the domestic goods depends on the amount of the total foreign consumption, the degree of openness of the foreign economy, the elasticity of the substitution between home and foreign goods, and the relative price of the home good to the aggregate price level in the foreign economy.

We will also define the equation for the net foreign assets as;

$$\mathcal{E}_t B^*_t = i^{LF}_{t-1}\left(\mathcal{E}_t B^*_{t-1} + \mathcal{E}_t P^*_t M_t - \mathcal{E}_t P_{X,t} X_t\right) \tag{98}$$

which is the sum of the domestic currency value of export and import, and the interest payment for the existing debt stock, where $i^{LF}_{t-1} = i^*_{t-1}\Phi^{CRP}_{t-1}\Phi^{MPX}_{t-1}$ is the augmented external borrowing rate.

By defining;

$$b^*_t = \frac{\mathcal{E}_t B^*_t}{P_t Y_t} \tag{99}$$

We can further write the foreign asset position as;

$$b_t^* = \frac{\mathcal{E}_t B_t^*}{P_t Y_t} = i_{t-1}^{LF}\left(\frac{P_{t-1}}{P_t}\frac{\mathcal{E}_t}{\mathcal{E}_{t-1}}\frac{Y_{t-1}}{Y_t}\frac{\mathcal{E}_{t-1}B_{t-1}^*}{P_{t-1}Y_{t-1}} + \frac{\mathcal{E}_t P_t^*}{P_t Y_t}M_t - \frac{\mathcal{E}_t P_{X,t}}{P_t Y_t}\frac{P_t^*}{P_t^*}X_t\right) \quad (100)$$

The log linear deviation of the foreign assets from its steady state:

$$\frac{b_{ss}^*}{i_{ss}^* \Phi_{ss}^{CRP}\Phi_{ss}^{MPX}}\left(\widehat{b_t^*} - \widehat{i_t^*} - \widehat{\Phi}_{t-1}^{CRP} - \widehat{\Phi}_{t-1}^{MPX}\right)$$
$$= b_{ss}^*\left(\widehat{\Delta e_t} - \widehat{\Delta y_t} - \widehat{\pi_t} + \widehat{b_{t-1}^*}\right) + \frac{M_{ss}}{Y_{ss}}\left(\widehat{q_t} + \widehat{m_t} - \widehat{y_t}\right) \quad (101)$$
$$- \frac{X_{ss}}{Y_{ss}}\left(\widehat{q_t} + \widehat{t_{X,t}} + \widehat{x_t} - \widehat{y_t}\right)$$

Table 2. The Log-Linearized Model

The Consumption Euler Equation	$\hat{c}_t = E_t\hat{c}_{t+1} - \frac{1}{\sigma}(\hat{\imath}_t - E_t\hat{\pi}_{t+1}) + \varepsilon_t^C$
The Production Function	$\hat{y}_t = \hat{a}_t + \hat{n}_t$
Labour Supply	$\hat{n}_t = \frac{1}{\varphi}(\hat{w}_t - \sigma\hat{c}_t)$
Marginal Cost of Domestic Goods	$\widehat{mc}_t = \hat{w}_t - \hat{a}_t$
Marginal Cost of Imported Goods	$\widehat{mc}_{M,t} = \widehat{mc}_{M,t-1} + \Delta\hat{s}_t + \hat{\pi}_t^* - \hat{\pi}_{M,t}$
Marginal Cost of Exported Goods	$\widehat{mc}_{X,t} = \widehat{mc}_{X,t-1} - \Delta\hat{s}_t + \hat{\pi}_{H,t} - \hat{\pi}_{X,t}$
The Inflation Dynamics of Domestic Goods (New Keynesian Philips Curve)	$\hat{\pi}_{H,t} = (1-\theta_H)(\hat{\tilde{p}}_{H,t} - \hat{p}_{H,t-1}) + \hat{\pi}_{H,t-1}$
The Inflation Dynamics of Imported Goods	$\hat{\pi}_{M,t} = \beta(1-\theta_M)E_t\hat{\pi}_{M,t+1} + \theta_M\hat{\pi}_{M,t-1} + \lambda_M\widehat{mc}_{M,t}$
The Inflation Dynamics of Exported Goods	$\hat{\pi}_{X,t} = \beta(1-\theta_X)E_t\hat{\pi}_{X,t+1} + \theta_X\hat{\pi}_{X,t-1} + \lambda_X\widehat{mc}_{X,t}$
Consumer Price Inflation	$\hat{\pi}_t = (1-\alpha)\hat{\pi}_{H,t} + (\alpha)\hat{\pi}_{M,t}$
The ratio of domestic prices to the total consumer prices	$\hat{\gamma}_{H,t} = \hat{\gamma}_{H,t-1} + \hat{\pi}_{H,t} + \hat{\pi}_t$
The ratio of import prices to the total consumer prices	$\hat{\gamma}_{M,t} = \hat{\gamma}_{M,t-1} + \hat{\pi}_{M,t} - \hat{\pi}_t$

Table 2. The Log-Linearized Model (contd.)

The ratio of export prices to the total foreign prices	$\hat{\gamma}_{X,t} = \hat{\gamma}_{X,t-1} + \hat{\pi}_{X,t} - \hat{\pi}_t^*$
Import Dynamics	$\hat{m}_t = -\eta\hat{\gamma}_{M,t} + \hat{c}_t$
Export Dynamics	$\hat{x}_t = -\eta^*\hat{\gamma}_{X,t} + \hat{y}_t^*$
External Balance	$\frac{b_{ss}^*}{i_{ss}^*\Phi_{ss}^{CRP}\Phi_{ss}^{MP}}\left(\widehat{b_t^*} - \widehat{i_t^*} - \widehat{\Phi_{t-1}^{CRP}} - \widehat{\Phi_{t-1}^{MPX}}\right) = b_{ss}^*\left(\Delta\widehat{s_t} - \widehat{\Delta y_t} - \hat{\pi}_t + \widehat{b_{t-1}^*}\right) + \frac{M_{ss}}{Y_{ss}}\left(\widehat{q_t} + \widehat{m_t} - \hat{y}_t\right) - \frac{X_{ss}}{Y_{ss}}\left(\widehat{q_t} + \widehat{t_{X,t}} + \hat{x}_t - \hat{y}_t\right)$
Financial System Dynamics	$\hat{i}_t^{LD} = \hat{i}_t^{CB} + \hat{\Phi}_t^{MP}$; $\hat{i}_t^{LF} = \hat{i}_t^* + \hat{\Phi}_t^{CRP} + \hat{\Phi}_t^{MPX}$; $\hat{i}_t^{D} = \hat{i}_t^{CB}$
Country Risk Premium	$\hat{\Phi}_t^{CRP} = \varphi^{CRP}\hat{b}_t^* + \hat{\varepsilon}_t^{CRP}$
Uncovered Interest Parity Condition	$\hat{i}_t^{LM} - \hat{i}_t = E_t\Delta\hat{z}_{t+1}$
The Real Exchange Rate	$\hat{q}_t = \hat{q}_{t-1} + \hat{s}_t - \hat{s}_{t-1} + \hat{\pi}_t^* - \hat{\pi}_t$
Monetary Policy Equations	$\hat{i}_t^{CB} = \psi_i\hat{i}_{t-1}^{CB} + (1-\psi_i)\left[\psi_\pi\hat{\pi}_t + \psi_y\hat{y}_t\right]$ $\hat{\Phi}_t^{MP} = \psi_{MP}\hat{\Phi}_{t-1}^{MP} + (1 - \psi_{MP})\left[\psi_{q,MP}\hat{q}_t + \psi_{l,MP}\hat{l}_t + \psi_{tb,MP}\widehat{tb}_t\right]$ $\hat{\Phi}_t^{MPX} = \psi_{MPX}\hat{\Phi}_{t-1}^{MPX} + (1 - \psi_{MPX})\left[\psi_{q,MPX}\hat{q}_t + \psi_{l,MPX}\hat{l}_t + \psi_{tb,MPX}\widehat{tb}_t\right]$
Foreign Economy Dynamics (Exogenous)	$\pi_t^* = \lambda_{\pi^*}\pi_{t-1}^* + \varepsilon_t^{\pi^*}$; $y_t^* = \lambda_{y^*}y_{t-1}^* + \varepsilon_t^{y^*}$; $i_t^* = \lambda_{i^*}i_{t-1}^* + \varepsilon_t^{i^*}$
Structural Shocks:	
Consumption	$\varepsilon_t^C = 0.80\,\varepsilon_t^C + u_t^C$; $u_t^C \sim WN(0, \sigma_C^2)$
Country Risk Premium	$\varepsilon_t^{CRP} = 0.80\,\varepsilon_t^{CRP} + u_t^{CRP}$; $u_t^{CRP} \sim WN(0, \sigma_{CRP}^2)$
Technology	$\varepsilon_t^a = 0.80\,\varepsilon_t^a + u_t^a$; $u_t^a \sim WN(0, \sigma_a^2)$
Foreign Inflation	$\varepsilon_t^{\pi^*} = 0.80\,\varepsilon_t^{\pi^*} + u_t^{\pi^*}$; $u_t^{\pi^*} \sim WN(0, \sigma_{\pi^*}^2)$
Foreign Output	$\varepsilon_t^{y^*} = 0.80\,\varepsilon_t^{y^*} + u_t^{y^*}$; $u_t^{y^*} \sim WN(0, \sigma_{y^*}^2)$
Foreign Interest Rate	$\varepsilon_t^{i^*} = 0.80\,\varepsilon_t^{i^*} + u_t^{i^*}$; $u_t^{i^*} \sim WN(0, \sigma_{i^*}^2)$

3.2. Calibration of the Model

We have been consistent with the literature in specifying the model parameters. Especially, regarding the parameters of the domestic economy we have utilized the studies on Turkish economy, of which Alp and Elekdağ (2011), Çebi (2012) and Çufadar (2012) are the main studies to mention but a few.

In line with the literature, the coefficients of the AR (1) structural shocks are set as 0.80 in order to create sufficiently significant persistence.

The calibrated parameters are listed in Table 3.

Table 3. Calibrated Parameters

Parameter	**Symbol**	**Value (Policy I / Policy II)**
Discount Factor	β	0.99 / 0.985
Consumption intra-temporal elasticity of substitution	η	1.00
Elasticity of export demand	η^*	0.25
Share of imported goods in consumption	α	0.25
Relative risk aversion	σ	1.00
The inverse elasticity of the labour	φ	2.00
Mark up in domestic goods	μ^H	0.15
Calvo parameter for domestic goods	θ_H	0.31
Calvo parameter for imported goods	θ_M	0.55
Calvo parameter for exported goods	θ_X	0.55
Elasticity of country risk premium	φ^{CRP}	0.05
Country risk premium	Φ_{ss}^{CRP}	1.005
Macro-prudential policy premium	Φ_{ss}^{MP}	1 / 1.005
External borrowing macro-prudential policy premium	Φ_{ss}^{MPX}	1 / 1.005
External debt stock	b_{ss}^*	0.40
The interest rate smoothing parameter	ψ_i	0.70
The coefficient of the inflation gap	ψ_π	3.2 / 3.3
The coefficient of the output gap	ψ_y	0.2 / 0.1
The macro-prudential tool rate smoothing parameter	ψ_{MP}	0.70
The coefficient of the loan stock gap	$\psi_{l,MP}$	0.50

Table 3. Calibrated Parameters (contd.)

The coefficient of the trade balance gap	$\psi_{tb,MPX}$	0.6
The coefficient of the real exchange rate gap	$\psi_{q,MPX}$	-0.8
The macro-prudential tool rate smoothing parameter	ψ_{MPX}	0.70

3.3. The Steady State Equations

The steady state values for the main endogenous variables are derived by dropping time indices and assuming that the steady state the inflation rates for foreign and domestic economy are $\Pi = 1$ and Π^*=1 respectively. The productivity is assumed to be $A = 1$ and the relative prices are $\hat{\gamma}_{H,t}, \hat{\gamma}_{M,t}, \hat{\gamma}_{X,t}$ equal to 1.

Using the equation (11) for the Euler condition;

$$\beta E_t \left[\left(\frac{C}{C} \right)^{-\sigma} \frac{P}{P} \right] i_t^D = 1 \tag{102}$$

we obtain the steady state value for the domestic interest rate:

$$i_{ss}^D = \frac{1}{\beta} \tag{103}$$

Using the equation (41) for the Uncovered Interest Parity Condition we get the condition for the foreign interest rates;

$$i_{ss}^D = i_{ss}^* \, E_t \left(\frac{\mathcal{E}}{\mathcal{E}} \right) = i_{ss}^{CB} \tag{104}$$

For the macro-prudential policy variable we can use the similar identity and assuming that the macro-prudential cost is bigger than zero we can write;

$$i_{ss}^{LD} = i_{ss}^D \Phi_t^{MP} = i_{ss}^* \Phi_t^{MP} \tag{105}$$

Assuming the rental rate for the working capital is the average of the domestic and foreign lending rates, we obtain;

$$r_{ss} = (i_{ss}^{LF} + i_{ss}^{LD})/2 \tag{106}$$

The price of the final good is set with a mark-up over the marginal cost so that we can write;

$$P = (1 + \mu^{H})MC \tag{107}$$

And the steady state value of the real marginal cost will be;

$$mc_{ss} = \frac{1}{1 + \mu^{H}} \tag{108}$$

Assuming zero trade deficit at steady state and using the equilibrium condition in the goods market we can derive the steady state conditions for the trade deficit and the foreign assets as;

$$\frac{\mathcal{E}B^{*}}{PY} = i^{*}\Phi^{CRP}\Phi^{MP}\left(\frac{\mathcal{E}B^{*}}{PY} + \frac{\mathcal{E}P^{*}}{PY}M_{t} - \frac{\mathcal{E}P_{X}}{PY}X_{t}\right) \tag{109}$$

Or, in the steady state we can represent;

$$b_{ss}^{*} = \frac{i_{ss}^{*}\Phi_{ss}^{CRP}\Phi_{ss}^{MPX}}{((i_{ss}^{*} - 1) + \Phi_{ss}^{CRP}\Phi_{ss}^{MPX} - 1)}\left(\frac{X_{ss}}{Y_{ss}} - \frac{M_{ss}}{Y_{ss}}\right) \tag{110}$$

meaning that a positive debt stock necessitates a positive trade balance.

Given the import share (α) of the output, we can write the steady state condition for the exports as;

$$\frac{X_{ss}}{Y_{ss}} = \alpha + \frac{((i_{ss}^{*} - 1) + \Phi_{ss}^{CRP}\Phi_{ss}^{MPX} - 1)}{i_{ss}^{*}\Phi_{ss}^{CRP}\Phi_{ss}^{MPX}}b_{ss}^{*} \tag{111}$$

Therefore we can get the condition for the domestic market equilibrium as;

$$(1 + \alpha + tb_{ss})Y_{ss} = C_{T,ss} + X_{ss} \tag{112}$$

where;

$$tb_{ss} = \left[\frac{X_{ss}}{Y_{ss}} - \frac{M_{ss}}{Y_{ss}}\right] \quad (113)$$

Table 4. Steady State Values for Alternative Policy Options

Value	**Description**	**Policy Tool: Interest Rate**	**Policy Tool: Interest Rate + Macro-prudential Tools**
$i_{ss}^{*} = i_{ss}^{D}$	Domestic and Foreign interest rates	1.010	1.015
$i_{ss}^{LD} = i_{ss}^{D}\Phi_{ss}^{MP}$	Domestic Lending Rate	1.010	1.020
$i_{ss}^{LF} = i_{ss}^{*}\Phi_{ss}^{CRP}\Phi_{ss}^{MPX}$	Foreign Lending Rate	1.015	1.025
$r_{ss} = (i_{ss}^{LF} + i_{ss}^{LD})/2$	Average Lending Rate	1.013	1.023
mc_{ss} mc_{ss}	Marginal Cost	0.87	0.87
C_{ss}/Y_{ss}	Consumption / GDP	0.994	0.990
X_{ss}/Y_{ss}	Exports / GDP	0.256	0.260
M_{ss}/Y_{ss}	Imports / GDP	0.250	0.250
tb_{ss}	Trade Balance	0.006	0.010
C_{ss}^{H}/Y_{ss}	Consumption share in production	0.744	0.740
X_{ss}^{H}/Y_{ss}	Exports share in production	0.256	0.260

3.4. Parameter Analysis

Calibrated parameters in Table 3. and the steady state values in Table 4. reveal further information about the working mechanism of the model and display the role of the additional policy tools in this mechanism.

The degree of opennes (α) is set as 0.25 which is a benchmark value for the studies on Turkish economy and shows how much of the total consumption is composed of imported goods.

We set the discount factor (β) as 0.99 when the monetary authority follows "Policy I"

and uses only the interest rate as the monetary policy tool, which then implies 4.0 % annual interest rate. When the monetary authority follows "Policy II" and uses additional macro-prudential tools which includes a capital control tool, the discount factor decreases to 0.985 and leads to 4.5 % annual interest rate. The inclusion of macro-prudential tools increases the funding cost of the domestic financial system. Yet, the household seems indifferent between a future consumption and present consumption in both cases since high discount factor reflects patient households.

The inverse of the elasticity of substitution in consumption is set as $\sigma = 1$ which means that the households change their consuption one-by-one in response to changes in interest rates. The inverse elasticity of labour supply is set as $\varphi = 2$ which implies that labour supply increases half of an increase in the real wages and reflects the non-elasticity of labour supply.

The elasticity of substitution between domestic and foreign goods is set as $\eta = 1$, which means that the household is indifferent between them and can modify its consumption one-by-one according to changes in the prices of those goods.

Regarding with the price setting, $\theta_H = 0.31$ of the domestic producers, $\theta_M = 0.55$ of the importing firms and $\theta_X = 0.55$ of the exporters don't change their prices. It means that the price of the domestic goods stay unchanged for about $1/(1-\theta_H) = 1{,}4$ months and the duration for the price of both imported and exported goods are 2.2 months.

The parameters of the monetary policy tools convey information about the policy approach of the monetary authority. Regarding with the interest rate tool;

$$\hat{\imath}_t^{CB} = 0.70\hat{\imath}_{t-1}^{CB} + (1-0.70)\,[3.30\,\hat{\pi}_t + 0.10\,\hat{y}_t]$$

The interest rate smoothing parameter ($\psi_i = 0.70$) reflects the effect of the last period's interest rate in the present interest rate and the parameter ($1-\psi_i$) reflects the impact of the inflation level and output gap in interest rate decision. The comparison of the coefficients of the inflation rate ($\psi_\pi = 3.30$) and output gap ($\psi_y = 0.20$) release that the central bank response to the deviations of the the inflation level from its target more than the volatilities in output gap while fixing the interest rates. The

central bank changes the interest rate 0.99 % in response to 1% deviation in inflation while it is only 0.03 % change in interest rate for a 1 % deviation in output gap.

Regarding with the first macro-prudential tool;

$$\widehat{\Phi}_t^{MP} = 0.7\widehat{\Phi}_{t-1}^{CB} + (1 - 0.7)\left[0\ \hat{q}_t + 0.6\ \hat{l}_t + 0\ \widehat{tb}_t\right]$$

It is designed to contain the undesirable growth in credits. The coefficient of the loan stock gap shows that the response of the macro-prudential tool to a 1 % deviation in loan stock is 0.18 %.

Finally, regarding with the second macro-prudential tool;

$$\widehat{\Phi}_t^{MPX} = 0.70\ \widehat{\Phi}_{t-1}^{MPX} + (1 - 0.70)\left[-0.80\ \hat{q}_t + 0\ \hat{l}_t + 0.60\ \widehat{tb}_t\right]$$

The response to 1% increase in real exchange rate is - 0.24 % while it is 0.18 % in response to 1% increase in trade balance gap.

CHAPTER 4: A BAYESIAN SVAR ANALYSIS OF MACRO - PRUDENTIAL POLICIES OF THE CENTRAL BANK OF THE REPUCLIC OF TURKEY

In this chapter, we provide some empirical evidence on whether the new policy mix, in particular the reserve option mechanism (ROM), has been successful in containing the key macroeconomic variables such as domestic credit conditions, the external balance, the exchange rate and domestic inflation and in promoting macroeconomic activity. Turkey constitutes a splendid example for this study: first, it is one of the hardest hit countries by the crisis. Second, it devised the monetary policy and started to implement two novel monetary policy tools right after the crisis. Third, it has a long history of homogeneous monetary policy practice since 2000 (beginning of inflation targeting regime). The homogeneous monetary policy period is important for empirical research because the reserve requirements would have different effects if the central bank had different targets other than interest rates (Glocker and Towbin 2015).

As a macroprudential instrument reserve requirement is utilised not only by Turkey but also by other advanced and emerging countries as well, and particularly itself received very high attention in academic circles. Curdia and Woodford (2011), for instance, study the contribution of reserve remuneration under the zero-lower bound. Kashyap and Stein (2012) analyse the role of reserve requirements in search of an optimal monetary policy and its use as a financial stability tool. Both studies are on advanced economies and suggest that the reserve requirement has re-emerged as a financial stability tool in the post crisis period. Studies on emerging countries mostly focus on the behaviour of the banking sector, such as the impact of reserve requirements on the banking spreads and the credit growth (Herrera et al. 2010; Glocker and Towbin 2012; Tovar et al., 2012; Armas et al., 2014) and are lacking in the effects on other aggregate or external factors, such as GDP, unemployment, current account, or inflation. Alternatively, Glocker and Towbin (2015) provide a broadly-based analysis of reserve requirements and investigate the joint dynamics of the basic macroeconomic variables. Lubis et al. (2021) also investigate the effect of reserve requirements as a macroprudential instrument on macroeconomic variables of the Indonesian economy with a comprehensive approach.

Reserve requirements as a macroprudential instrument in Turkey has also received the attention of scholars, especially in the first couple of years of the implementation of the new policy mix. The most notable examples are as follows: Alper et al. (2014) focus on the interaction between reserve requirements and the bank lending behaviour. Aslaner et al. (2015) and Oduncu et al. (2013) analyse the reserve requirement policy in Turkey by the reserve option mechanism (ROM) and both follow a partial equilibrium approach. Other papers explain the effectiveness of reserve requirements as a macroprudential tool. Among them, Sahin et al. (2015) emphasise the supportive effect of the ROM in controlling the capital flow and Erten and Gezici (2014) emphasise the complementary effect of reserve requirements in reducing the capital flows. Değerli and Fendoğlu (2015) proves its stabilising role on the excessive movements of the exchange rate. In a more recent study, Binici, Kara and Özlü (2019) employ reserve requirements as an additional variable in order to explain the private bank's lending and borrowing behaviour rates during the QE period and underline the significance of reserve requirements on commercial loan and deposit rates.

Like the literature on emerging markets, the literature on Turkey has almost entirely focused on the effect of reserve requirements, as a macroprudential instrument, on the banking sector and short-term financial indicators. Varlık and Berument (2016) include industrial production and imports in their VAR and this constitutes an exception. However, the sample covers the period from January 1992 until May 2013 which cannot be characterised as a period of homogeneous monetary policy practice. Moreover, it only covers the initial period of macroprudential policy practice. Varlık and Berument (2017) investigate the effect of different monetary policy rates on economic performance including the upper and lower bounds of the interest rate corridor, which constitutes another exception. Our study is a contribution to this literature and complements it in two important ways. First, it is a contribution to the impact of macroprudential policy on the macroeconomy and not only on the banking or financial sector. In this sense, we contribute to the literature on macroprudential policy in emerging markets as well. Second, we analyse the entire period when the macroprudential mix was in place rather than focusing on the initial years and study both macroprudential instruments.

4.1. Data and Methodology

Macroeconomic variables usually have a contemporaneous relationship between endogenous variables, so the vector auto-regression (VAR) estimation in reduced form is incapable of revealing how the endogenous variables affect each other as the reduced form residuals are not orthogonal. The seminal work of Sims (1980) introduced the structural vector autoregressive (SVAR) framework to capture interdependencies between endogenous variables. Nevertheless, the SVAR model cannot be estimated directly because of the feedback effects from contemporaneous variables. The reduced-form VAR, on the other hand, contains predetermined time series and can be estimated. So, it is possible to start with a reduced-form model and retrieve the structural parameters and shocks by imposing identifying restrictions on the parameters in the coefficient and residual covariance matrices.

In order to estimate the model, we used a Bayesian methodology. We imposed a set of timing, zero and sign restrictions in a nine-variable structural vector auto-regression (SVAR) system to identify the reserve requirement and the interest rate shocks. We followed the method introduced by Arias et al. (2014) by using the notation borrowed from Dieppe et al. (2016). We started by writing the reduced form of the estimated model as:

$$y_t = \Psi x_t + \sum_{i=1}^{p} A_i\, y_{t-i} + e_i \quad \text{with} \quad e_t \sim N(0, \Sigma) \quad t = 1, \ldots, T \qquad (1)$$

where, $y_t = (y_{1,t}, y_{2,t}, \ldots, y_{n,t})$ is an $n \times 1$ vector of endogenous variables, x_t is an $m \times 1$ vector of exogenous variables (constant terms, time trends, exogenous data series), ε_t is a reduced-form error term with variance covariance matrix Σ, p is the lag length, $(A_1, A_2, \ldots.. A_p)$ are $n \times n$ coefficient matrices and C is an $n \times m$ coefficient matrix.

Next, we specified the model in structural form.

$$D_0 y_t = F x_t + \sum_{i=1}^{p} D_i\, y_{t-i} + \eta_t \quad \text{with} \quad \eta_t \sim N(0, \Gamma) \quad t = 1, \ldots, T \qquad (2)$$

η_t is a vector of structural innovations with variance covariance matrix Γ. For notational purpose define $D = D_0^{-1}$ and pre-multiply both sides of Equation (2) by D:

$$A_i = DD_i \quad (3)$$

$$C = DF \quad (4)$$

$$\varepsilon_t = D\eta_t \quad (5)$$

The one step ahead prediction error ε_t is where we looked to understand how structural shocks are transmitted through the economy. The method used to decompose ε_t into economically meaningful forms in order to understand this transmission mechanism deserves special attention. Equation (5) represents ε_t as a linear combination of orthonormal structural shocks $\varepsilon_t = D.\eta_t$, where suppose $E(\eta_t\eta_t') = In$ and D is the impact matrix of each structural shock. In this representation D serves as a structural matrix and helps to recover structural innovations from the reduced-form VAR residuals. In other words, the matrix D shows the immediate response of endogenous variables to one standard error innovation in ε_t. The only restriction on the matrix D comes from the form of the variance-covariance matrix:

$$\Sigma = E[\varepsilon_t\varepsilon_t'] = E[D\eta_t\eta_t'D'] = DD' \quad (6)$$

This equation gives us as many as $n(n-1)/2$ degrees of freedom in specifying D matrix (given n^2 elements of D to identify, and $n(n+1)/2$ restriction from Σ, there remains $n(n-1)/2$ restrictions to identify D matrix). Since the current restrictions on D matrix was not enough to identify the shocks to ε_t, we needed further restrictions on D. As discussed in detail in Section 3.2, in order to identify the reserve requirement and the interest rate shocks, we applied a combination of sign and zero restrictions as proposed in Uhlig (2005) and followed the algorithm as presented in Arias at al. (2014).

4.1.1. Data

The CBRT started to employ macroprudential instruments in the last quarter of 2010 when the aftershock of the financial crisis started to come ashore in Turkey. Following an intense implementation of this multi-tooled monetary policy, as the global economic outlook started to normalise, the country announced its roadmap to simplify the monetary policy implementation in August 2015. The main incentive of this simplification was to form a more predictable monetary policy to improve the

expectations of the economic agents. As of May 2018, the CBRT completed the simplification period and the interest rate corridor was abolished. Moreover, the active use of the ROM has been diminished gradually, and the CBRT declared that it will end its usage in 2022[1].

We used monthly data from October 2010 to May 2018, in which both instruments were actively used, in order to capture not only the effect of each policy instrument on the economy but also to analyse the interaction between them. While the time span does not seem to be very long, the period contains adequate data to judge the effectiveness of the new policy approach with Bayesian methodology. Besides, given our sample size, we formulated a SVAR model that could capture the effects of the reserve requirement policy shocks and the interest rate shocks with a minimum number of variables. The endogenous variables include unemployment (U), the consumer price index (CPI), the current account (CA), the spread between deposit and the lending rates (SPRD), the bank credits (CRED), the bank reserves (RSRV) and the exchange rate (USD) and two variables that are directly related to the new macro-prudential policy mix: a measure for the reserve requirement policy (RR) and the overnight interest rate (ON)[2]. The lag length was chosen as one based on the following standard tests for choice of lag length: Likelihood Ratio test (LR), the Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQ) and Schwarz Information Criterion (SC). At this lag length, the null hypothesis of no autocorrelation could not be rejected by the Lagrange Multiplier (LM) test. Based on the outcome of the seasonality tests[3], the consumer price index, the current account and the real credit were seasonally adjusted with the Tramo/Seats method.

We included the volatility index (VIX), the Industrial Production Index for the European Union (IP), the commodity price index (CP) and the US Federal Funds rate (FED) as exogenous variables to capture the external effects on a small open economy, Turkey. The exogenous variables were entered into the model with two lags and the vector of exogenous variables also included a time trend as a deterministic variable.

We tested the stationarity of our variables and provided the unit root test results as Supplementary material. We conducted in total 6 unit-root tests: Augmented Dickey Fuller (ADF) unit root test with an intercept and with or without a trend term, Phillips-Perron (PP) unit root test with an intercept and with or without a trend term and the

Kwiatkowski–Phillips–Schmidt–Shin (KPSS) unit root test with an intercept and with or without a trend term. All unit root tests unanimously found that CPI, domestic credit (CRED), reserves (RSRV), exchange rate (USD) and federal funds rate (FED) are nonstationary. The results of the rest of the variables were mixed. Even though the analysis employed nontionary macroeconomic data, we used all variables in levels as recommended in Sims (1980) and Sims et al. (1990), discussed in Enders (2010), Fanchon and Wendel (1992), Christiano et al. (1999), Uhlig, (2005) and Binatli and Sohrabji (2019) are the examples of VARs with nonstationary macroeconomic variables in levels. Carriero et al. (2015) further analysed Bayesian VARs with possibly nonstationary macroeconomic variables in levels along the lines of Sims (1980) and concluded that modelling choices lead to very small losses in forecasting power, thus making BVARs a versatile econometric tool.

4.1.2. Identification of Structural Shocks

The main question here was how to formulate a reliable identification scheme. There are several methods of identification in the VAR literature. The recursive approach (Cholesky ordering) imposes short run restrictions on model parameters and assumes that the central bank does not influence the fast-moving variables in the short run, as implemented by Fatas and Mihov (2001) and Tovar et al. (2012). The sign restriction approach imposes restrictions on impulse response functions, as in Mountford and Uhlig (2009) and Glocker and Towbin (2015), whereas the narrative approach imposes restrictions on the structural parameters in line with the key historical events so as to ensure that the structural shocks represent those episodes, such as in the studies by Federico et al. (2012), Antolín-Díaz and Rubio-Ramírez (2018) and Rojas et al. (2020).

In our identification scheme, we imposed timing, zero and sign restrictions on impulse response functions to identify the reserve requirement shock and the interest rate shock. We followed economic theory and used exact identification, which resulted in more accurate impulse response functions and a unique *D* matrix for a given parameter estimate.

A positive reserve requirement shock will trigger an increase in bank reserves and in reserve requirements. The theory behind this reaction is that the central bank needs to increase the nominal reserves in order to compensate for the upward pressure of

reserve requirements on the policy rate.

A positive interest rate shock on the other hand reflects an increase in prices and a reduction in bank reserves. The implementation of an interest rate rise is executed by withdrawing money, which results in lower reserves. We further propose that the price level responds negatively in the second period to eliminate the price puzzle (Sims 1992; Christiano and Eichenbaum 1992).[4]

In order to identify the two policy shocks of the CBRT, we followed (Glocker and Towbin, 2015) and defined a block of slow-moving variables which responded to policy shocks with delay. This block of slow-moving variables included unemployment, the price level and the current account. The fast-moving variables on the other hand responded to shocks within a month and included the nominal exchange rate, total credit, bank reserves and the spread. The timing (or zero) restrictions were imposed on the slow-moving variables for one month and the sign restrictions were imposed on the fast-moving variables for three months. Where there was not a consensus on the response of the variables, the response was left unrestricted and an agnostic approach was accepted; the impulse responses were determined by the estimated model. The identification restrictions are summarised in Table 5.

Table 5. Identification restrictions.

Variable	RR Shock	Interest Rate Shock
U	0	0
CPI	0	≤0
CA	0	0
SPRD	0	0
RR	≥0	●
ON	●	≥0
CRED	●	●
USD	●	●
RSRV	≥0	≤0

Note: We imposed zero restrictions to only the first month and the sign restrictions were applied to the first quarter. The response of the CPI to an interest rate shock was left agnostically open in the first month and the sign restriction was applied in the second and the third month. For the definitions of the data, see Appendix A.

In order to impose the zero, timing and sign restrictions, we exploited the BEAR toolbox by Dieppe et al. (2016), which followed the same algorithm as presented in Arias et al. (2014). In Bayesian framework *D* is regarded as a random variable, like parameters of the VAR system. Therefore, the algorithm drew the impact matrix *D* from the posterior distribution of structural parameters conditional on zero restrictions and applied the *QR* decomposition $D = QR$. Each column of the *Q* matrix was selected recursively by standard normal distribution on R^n. The recursive selection of *Q* matrix proved that it was selected from a uniform distribution of the posterior of structural parameters conditional on zero restrictions. If the sign restrictions were satisfied the draw was kept. The procedure proceeded until the required number of draws was obtained. In our study, the algorithm worked until 1000 accepted draws were obtained.

The prior selection is another important stage of the Bayesian VAR analysis. Since the literature lacks adequate previous study using Bayesian techniques to analyse the reserve requirement and the interest rate policy in Turkey, there are no ready-to-use priors to rely on. Therefore, we employed the analysis for Minnesota prior, Normal-Wishart prior and Independent Normal-Wishart prior, which are the benchmark priors in Bayesian VAR. The analysis presented in this study is based on the Minnesota prior which assumes that each variable follows a random walk and thus is appropriate for our sample with nonstationary variables.[5]

4.2. Empirical Findings

We display the impulse response functions iterated by using the identification scheme given in Table 5. Each response function displays the response of the given variable to a one standard deviation in the relevant shock. The solid blue line shows the median responses and the shadowed area around the line is 16% and 84% quantiles. Therefore, the shadowed area corresponds to a 68 percent credibility interval of the response.[6]

Impulse response functions to a reserve requirement shock are presented in Figure 13. The responses are largely in line with the literature and with the expectations from new policy tools implemented by the CBRT. With respect to the credit market, the spread rises for about seven months and the response stays positive for more than a year after a reserve requirement shock, which is a reasonable response considering the implicit tax effect[7]. Domestic credit is slow to respond initially but eventually declines

sluggishly after about eight months and remains so for two years. Alper et al. (2014) also noted that domestic credit remained stable in the initial months of the monetary tightening cycle. The response of domestic credit is slow and limited but persistent.

The exchange rate shows a fractional decline as an immediate response and wanders around the zero axis over the scope. We observe a distinct improvement in the current account which lasts for nearly one year.

The price level shows an insignificant downward response while the unemployment rate decreases slightly over a period of more than one year. The decline in the unemployment rate, although theoretically unexpected, reflects the dynamics of the Turkish economy in the period under study.

The increase in the reserves shows that the reduction in the bank reserves following an increase in the reserve requirement is compensated by the central bank but the increase in the policy rate further reveals that it performed only partially.

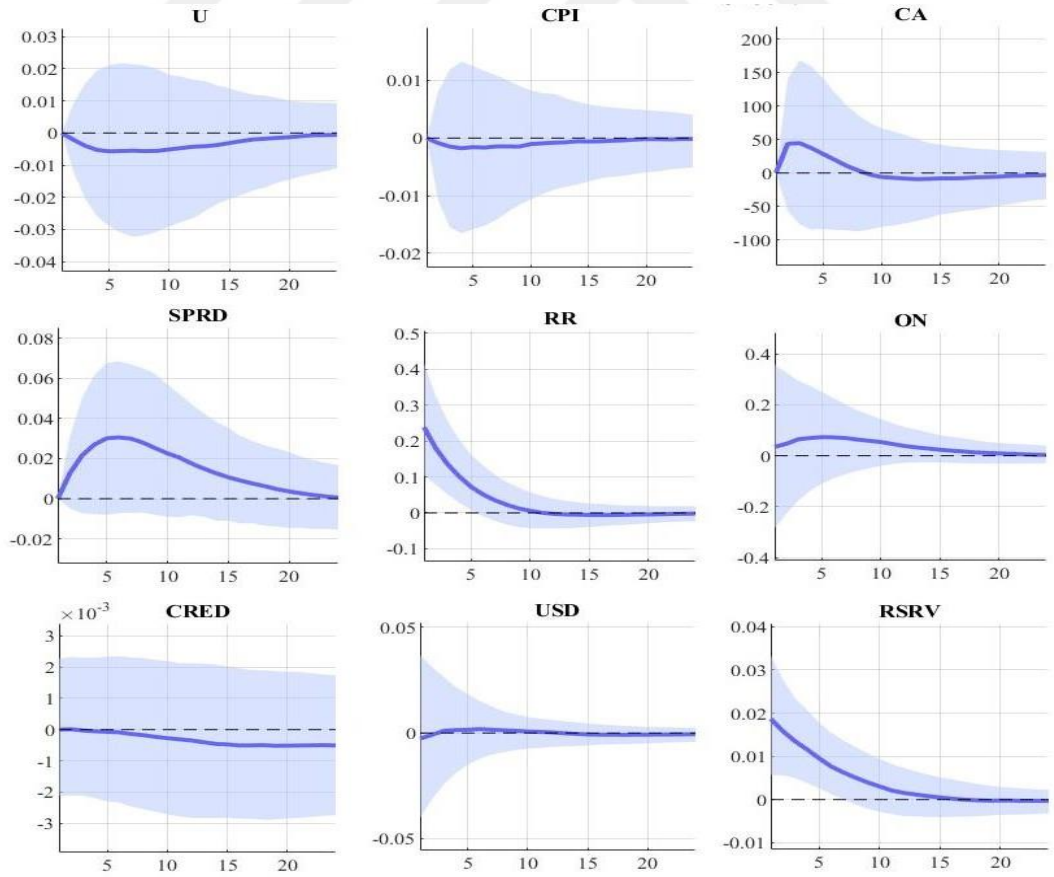


Figure 13. Responses to the reserve requirement shock.

Impulse response functions to an interest rate shock are presented in Figure 14. The responses are again consistent with the literature. We will compare our results with those of Glocker and Towbin (2015) for Brazil, since this is the most comparable analysis to ours given the methodology and the range of variables studied. In response to an increase in the overnight interest rate, which is the interest rate around which the corridor is constructed, the price level falls significantly, which shows that the identification scheme overcomes the price puzzle. A trough is reached after three months and this level is maintained for almost a year. In Glocker and Towbin (2015)'s analysis of Brazil, the price response to an interest rate shock is similar but lasts much longer: a trough is reached after a year and it takes another 18 months to die out.

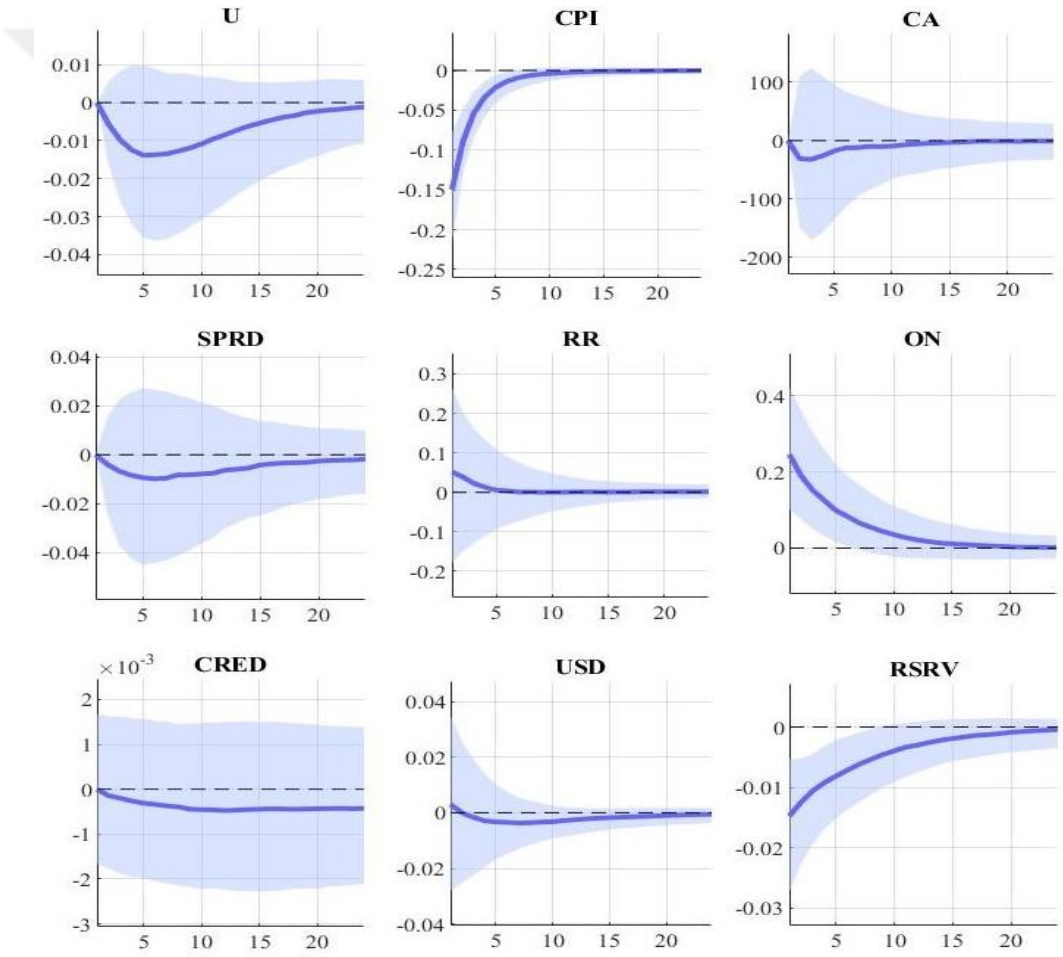


Figure 14. Responses to the interest rate shock.

Regarding the external variables, the nominal exchange rate appreciates only infinitesimally and then navigates around the zero axis. The response in Brazil is an initial appreciation of 5% and the currency does not depreciate back to its initial level

for almost a year. The interest rate shock in Turkey does not help increase the value of the currency but only helps maintain it. The current account turns back to its balance after a slight deterioration for about one year, which is again an expected reaction. In comparison to Brazil, we again note that the response is faster and shorter lived. Surprisingly, the unemployment rate does not increase after a tightening of the monetary policy. This response of the unemployment rate is in line with our expectations since Turkish economy displayed a strong recovery after a short depression in 2009[8] owing to strong domestic and external demand.

The credit market shows an expected response so that the credit shrinks after the contractionary effect of the increase in the policy rate. The spread declines as the overnight rate increases which can be explained by the findings of Binici, Kara and Özlü (2019). They show that the overnight rate has an asymmetric effect on loan rates, affecting corporate loan rates more strongly than consumer loan rates.

Figure 15. shows the forecast error variance decomposition for the reserve requirement and the interest rate shocks, depicting what proportion of the variance in the variables is explained by each shock. In other words, the forecast error variance decomposition represents the importance of the intended shock on the variables and reveals the transmission mechanism of these policy tools.

After 24 months, both the reserve requirement and the interest rate shocks no longer have a significant effect on the variations in unemployment and the current account, about 2% and 1% respectively. Most of the variation in the consumer price index is explained by interest rate shock, which is to be expected from a contractionary monetary policy. The effect of the reserve requirement shock on the spread is surprisingly lower than what the theory predicts, about 3% over the two years horizon. This result may be attributed to indirect effects of other macroeconomic variables on the spread other than the reserve requirement shock. The main incentive in employing the two monetary policy tools was to contain credit growth and the volatility in the exchange rate. The results reveal that expectations are realised. The variations in domestic credits and the exchange rate are explained by the reserve requirement and the interest rate shocks to a large degree.

To further investigate the robustness of our findings, we use the weighted average

funding cost as the interest rate (WAFC), the headline consumer price index (CPI) and the producers price index (PPI) instead of CPI-D. The responses to both shocks are robust to the use of these alternative measures. These results are not presented here but they are provided as Supplementary material.

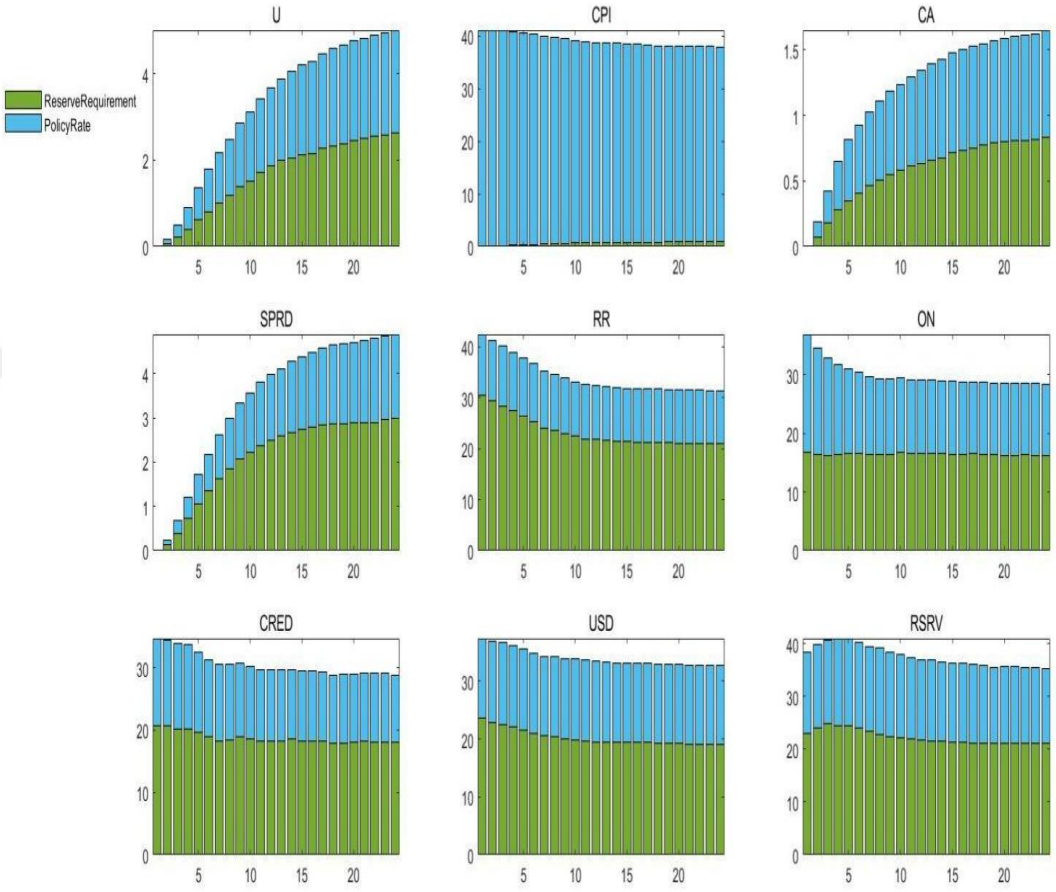


Figure 15. Forecast error variance decomposition.

4.3. Discussion

Our results are directly comparable to those of Glocker and Towbin (2015) for Brazil since both the methodologies and the range of variables studied are similar. Turkey and Brazil also share similarities regarding external risks. In Brazil, the response of the spread to a reserve requirement shock is almost identical. The response of domestic credit is immediate in contrast, but otherwise very similar, that is small in magnitude but persistent. So, in both Turkey and in Brazil, tightening lending conditions are observed after a positive reserve requirement shock. In Brazil, an improvement in the current account is observed accompanying a depreciation of the currency. In Turkey,

the reserve policy which enables banks to keep reserves in foreign currency makes it possible to improve the current account without a change in the value of the currency.

A reserve requirement as a macroprudential tool is successful in stabilising the economy and reducing unemployment. Glocker and Towbin (2015) found that unemployment in the Brazilian economy responds differently to a reserve requirement shock. Monetary tightening increases unemployment in Brazil.

The response of the Turkish credit market is qualitatively identical to the response of the Brazilian credit market but there are important differences as well. The fall in the spread is corrected after 10 months in Brazil but it takes twice as long in Turkey. The responses of the Turkish economy generally mean a faster return to pre-shock levels irrespective of the type of shock, but the response of the spread seems to be an exception which may be explained by the asymmetric effect of the overnight rate on loan rates.

4.4. Conclusions

In this chapter we utilised a Bayesian Structural Vector Autoregression (SVAR) model with sign and zero restrictions in order to analyse the capability of the new policy tools, namely the reserve option mechanism (ROM) and the interest rate corridor, of the Central Bank of the Republic of Turkey in restraining the harmful effects of the post-crisis period on the Turkish economy. The intended purpose of employing these tools was to control the exchange rate, the current account and limit credit growth to maintain the financial stability. The results reveal that the new policy frame is efficient in curbing the volatility in the exchange rates and in improving the current account balance. While the reserve requirements seem to be more effective on the current account and partly on the exchange rate, the interest rate is explicitly better in controlling the price level and credits. In this regard, the reserve option mechanism cannot be assumed as an alternative to the interest rate but rather functions as a supplementary instrument for achieving financial stability. Moreover, the results show that the new policy framework is efficient in curbing the adverse effects of volatile capital flows, at least during the period in which it is intensely implemented.

As discussed in the literature[9], financial stability is a much broader concept than price

stability, which necessitates the involvement of other regulatory authorities in policy making or restructuring the central banks to support financial stability. Therefore, at least in the Turkish case, we conclude that a comprehensive policy approach is needed to curb credit growth in order to maintain financial stability in periods of high capital inflow, which remains to be analysed in future work.

The policies implemented by the Turkish Central Bank in the aftermath of the global financial crisis represent a bold and novel policy framework that has had at least some of the intended consequences in periods when it was intensely used. The active use of this policy ended in May 2018. The Turkish economy exhibited negative growth in the last quarter of 2018 and the subsequent two quarters. The next year the COVID-19 pandemic wreaked havoc through the global economy as well as the Turkish economy. As the pandemic is considered to be over in many countries as well as in Turkey, the Turkish economy is experiencing much higher inflation than the rest of the world. The Turkish lira is very volatile and has depreciated by 60 percent between September 2021 and February 2022.[10] Monetary policy could have an important role to play in stabilising the Turkish economy during these turbulent times.

Notes

1. See Monetary and Exchange Rate Policy of the CBRT for 2019, 2020, 2021 and 2022.

2. See Appendix A, Table 6 for detailed information about definition and source of data. Figure 16 displays the time series plots of all the endogenous variables.

3. A battery of tests (both parametric and nonparametric) to detect seasonality, namely the test on autocorrelation on seasonal lags, the Friedman test, the Kruskal-Wallis test, the identification of seasonal peaks with the auto-regressive spectrum and Tukey periodogram and the test on regression with seasonal dummies were performed in JDemetra+ 2.2.3.

4. A surprise policy rate hike is followed by a consecutive increase in the inflation rate.

5. Using Normal-Wishart prior or Independent Normal-Wishart did not change the results significantly. The results are available upon request.

6. The upper and lower bounds here do not correspond to error bands. Credibility intervals render information about the distribution of impulse responses to a particular shock.

7. The increase in reserve requirements behaves like an implicit tax on the banking sector and widens the spread between deposit and the lending rates (Glocker and Towbin 2015).

8. Strong domestic and external demand helped the Turkish economy recover quickly. See Kara (2012) for the condition of the Turkish economy after 2008.

9. For alternative mechanisms see Özatay (2012), Ersel (2012), Basci and Kara (2011) and see BIS (2011), BoE (2011) for alternative objectives for the central banks. Bruno et al. (2017) show that macroprudential policies are more effective when they complement monetary policy tightening.

10. The average monthly TL/USD exchange rate retrieved on 18 March 2022 from the online database of the Central of Bank of the Republic of Turkey (https://evds2.tcmb.gov.tr/) (accessed on 18 March 2022) was 8.51 in September 2021 and 13.62 in February 2022.

REFERENCES

Adolfson, M., Laseen, S., Linde, J., and Villani, M. (2007) *Bayesian Estimation of An Open Economy DSGE Model with Incomplete Pass-Through,* Journal of International Economics, ol. 72, pp. 481-511.

Alper, K., Kara A. H. and Yörükoğlu, M. (2012) *Reserve Option Mechanism [Rezerv Opsiyonu Mekanizmasi]*. Ekonomi Notları, Central Bank of the Republic of Turkey, Vol. 2012–28.

Alper, K., Binici, M., Demiralp, S., Kara, A. H. and Ozlu, P. (2014) *Reserve Requirements, Liquidity Risk, and Credit Growth* [Online], Koc University-TUSIAD Economic Research Forum. Available at: https://EconPapers.repec.org/RePEc:koc:wpaper:1416 (accessed on 8 March 2021).

Alp, H. and Elekdağ, S. (2011) *The Role of Monetary Policy in Turkey during the Global Financial Crisis,* Working Paper No. 11/10, Research and Monetary Policy Department, Central Bank of the Republic of Turkey, Ankara.

Antolín-Díaz, J., and Rubio-Ramírez, J. F. (2018) *Narrative Sign Retrictions for SVARs.* American Economic Review, Vol. 108, pp. 2802–29.

Arias, J. E., Rubio-Ramirez, J. F. and Waggoner, D. F. (2014) *Inference Based on SVARs Identified with Sign and Zero Restrictions: Theory and Applications*. no. 1100, pp. 1-72. Federal Reserve Bank of Atlanta (US); Washington, DC: Board of Governors of the Federal Reserve System (US).

Armas, A., Castillo, P. and Vega., M. (2014) *Inflation targeting and quantitative tightening: Effects of Reserve Requirements in Peru,* Economia, Vol. 15, pp. 133–75.

Aslaner, O., Çıplak, U., Kara, A.H. and Küçüksaraç, D. (2015). *Reserve options mechanism: Does it work as an automatic stabilizer?* Central Bank Review, Vol.15, pp.1–18.

Aysan, A. F., Fendoğlu, S. and Kılınç, M. (2014). *Managing short-term capital flows in new central banking: Unconventional monetary policy framework in Turkey*, Eurasian Economic Review, Vol. 4, pp. 45–69.

Bartkiewicz, P. (2018) *The Impact of Quantitative Easing on Emerging Markets: Literature Review,* e-Finanse, Vol. 14, pp. 67–76.

Basci, E., and Kara, H. (2011) *Financial Stability and Monetary Policy*. Working Papers Vol. 1108, Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Belke, A., and Fahrholz, C. (2018) *Emerging and small open economies, unconventional monetary policy and exchange rates—A survey*. International Economics and Economic Policy, Vol.15, pp. 331–52.

Bhattarai, S., Chatterjee, A. and Park, W.Y. (2021) *Effects of US quantitative easing on emerging market economies,* Journal of Economic Dynamics and Control Vol. 122, pp. 1040-31.

Binatlı, A. O., and Sohrabji, N. (2019) *Monetary Policy Transmission in the Euro Zone*. Athens Journal of Business & Economics, Vol. 5, pp.79–92.

Binici, M., Kara, A. H. and Özlü, P. (2019) *Monetary transmission with multiple policy rates: Evidence from Turkey,* Applied Economics, Vol. 51, pp. 1869–93.

Binici, M., Kara, A.H., Ünalmış, D., and Özlü, P. (2013) *Interest Rate Corrdidor: A New Macroprudential Tool?* CBRT Research Notes in Economics 1320, Research and Monetary Policy Department, Central Bank of the Republic of Turkey, Ankara.

BIS. (2011). *Central Bank Governance and Financial Stability*. Report by Central Bank Governance Group. Bank for International Settlements. Basel.

BoE. (2011). *Instruments of Macroprudential Policy*. Bank of England Discussion Paper. Bank of England. London.

Borio, C. and Shim, I. (2007), What can macro-prudential policy do to support monetary policy? BIS Working Papers no. 242, Bank for International Settlement, Basel.

Bruno, V., and Shin, H. S. (2013) *Capital Flows, Cross-Border Banking and Global Liquidity*, Cambridge: National Bureau of Economic Research, no. w19038

Bruno, V., and Shin, H. S. (2014) *Assessing macroprudential policies: Case of South Korea*. The Scandinavian Journal of Economics, Vol. 116: pp. 128–57.

Bruno, V., Shim, I., and Shin, H. S. (2017) *Comparative assessment of macroprudential policies,* Journal of Financial Stability, Vol. 28, pp.183–202.

Calvo, G. A. (1993) *Staggered Price Setting in a Untility Maximizing Framework,* Journal of Monetary Economics, Vol. 12(3), pp. 383-398.

Calvo, G. A. (1998) *Capital flows and capital-market crises: The simple economics of sudden stops.* Journal of Applied Economics, Vol. 1, pp. 35–54.

Carriero, A., Clark, T. E., and Marcellino, M. (2015) *Bayesian VARs: Specification choices and forecast accuracy,* Journal of Applied Econometrics, Vol. 30, pp. 46–73.

Central Bank of the Republic of Turkey. (2015). *Road Map During the Normalization of Global Monetary Policies* [Online], Available at:

https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Announcements/Press+Releases/2015/CBRTRoadMap2015 (accessed on 15 June 2020)
Central Bank of the Republic of Turkey. (2018). *Press Release on the Operational Framework of the Monetary Policy*. [Online], Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Announcements/Press+Releases/2018/ANO2018-21 (accessed on 15 June 2020)
Central Bank of the Republic of Turkey. (2019). Monetary and Exchange Rate Policy for 2019 [Online], Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Monetary+and+Exchange+Rate+Policy+Texts (accessed on 7 December 2021)
Central Bank of the Republic of Turkey. (2020). Monetary and Exchange Rate Policy for 2020. [Online], Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Monetary+and+Exchange+Rate+Policy+Texts (accessed on 07 December 2021)
Central Bank of the Republic of Turkey. (2021). Monetary and Exchange Rate Policy for 2021. [Online], Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Monetary+and+Exchange+Rate+Policy+Texts (accessed on 7 December 2021)
Central Bank of the Republic of Turkey (2022). Monetary and Exchange Rate Policy for 2022. [Online], Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Monetary+and+Exchange+Rate+Policy+Texts (accessed on 7 December 2021)
Christiano, L., Ilut, C., Motto, R. and Rostagno, M. (2010), *Monetary Policy and Stock Market Booms*, NBER Workin Paper No. 16402, National Bureu of Economic Research, Cambridge.
Christiano, L. J., and Eichenbaum, M. (1992) *Liquidity effects and the monetary transmission mechanism.* The American Economic Review, vo. 82, pp. 346–53.
Christiano, L. J., Eichenbaum, M., and Evans, C. L. (1999) *Monetary policy shocks: What have we learned and to what end?* Handbook of Macroeconomics, Vol. 1, pp. 65–148.
Corsetti, G. (1998) *Paper Tigers? A Model of the Asian Crisis*, Working Paper no: 6783, National Bureau of Economic Research, Cambridge.
Cubas, G. (2012) *The Rate of Reserve Requirements and Monetary Policy in Uruguay: a DSGE Approach*, no. 12, Central Bank of Uruguay, Montevideo.

Curdia, V., and Woodford, M. (2011) *The central-bank balance sheet as an instrument of monetary policy*, Journal of Monetary Economics, Vol. 58, pp. 54–79.

Çebi, C. (2012) *The Interaction between Monetary and Fiscal Policies in Turkey: An Estimated New Keynesian DSGE Model*, Economic Modelling, Vol. 29, pp. 1258-1267.

Çufadar, A. (2014). *Monetary Policy Operating Framework For Financial and Price Stability: The Case of Turkey*, Ph.D. Thesis, Ankara, Council of Higher Education (YÖK).

Değerli, A., and Fendoğlu, S. (2015) *Reserve option mechanism as a stabilizing policy tool: Evidence from exchange rate expectations*, International Review of Economics and Finance, Vol. 35, pp. 166–79.

Dell'ariccia, G., Marquez, L. and Laeven, L. (2010) Monetary Policy, Leverage, and Bank Risk Taking, IMF working paper no. 10/276, International Monetary Fund, Washington DC.

Dieppe, A., van Roye, B., and Legrand, R. (2016) *The BEAR Toolbox*, European Central Bank, no. 1934, Frankfurt am Main.

Enders, W. (2010) *Applied Econometric Time Series*, 3rd ed. New York: Wiley, p. 303

Erdem, F.P., Özen, E. and Ünalmış, İ. (2017) *Are Macroprudential Policies Effective Tools to Reduce Credit Growth in Emerging Markets?* Working Papers no. 1712, Research and Monetary Policy Department, Central Bank of the Republic of Turkey, Ankara.

Ersel, H. (2012) *Finansal istikrarın sağlanması için nasıl bir mekanizma tasarlanabilir?* Iktisat Isletme ve Finans, Vol. 27, pp. 37–49.

Erten, B., and Gezici, A. (2014) *Macroprudential Regulations as Counter-Cyclical Tools: The Case of Turkey*. Conference Paper, URPE at ASSA

Fanchon, P., and Wendel, J. (1992) *Estimating VAR models under non-stationarity and cointegration: Alternative approaches for forecasting cattle prices.* Applied Economics, Vol. 24, pp. 207–17.

Fatas, A., and Mihov, I. (2001) *The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence*. CEPR Discussion Paper, No. 2760. London.

Federico, P., Vegh, C., and Vuletin, G. (2012) *Effects and Role of Macroprudential Policy: Evidence from reserve requirements based on a narrative approach*, Paper presented at the Understanding Macroprudential Regulation Workshop Organized by Norges Bank, Oslo, Norway, 29 November 2012.

Fendoğlu, S. (2017) *Credit Cycles and Capital Flows: Effectiveness of the Macropruential Policy Framework in Emerging Market Economies*, Journal of Banking and Finance, Vol. 79, pp. 110-128.

Gali, J. and Monacelli, T. (2005) *Monetary Policy and Exchange Rate Volatility in a Small Open Economy*, Review of Economic Studies, Vol. 72, pp. 707-734.

Gambacorta, L. and Signoretti, F.M. (2014) *Should Monetary Policy Lean Against the Wind? An Analysis Based on a DSGE Model with Banking*, Journal of Economic Dynamics and Control, Vol. 43, pp. 146-174.

Glocker, C., and Towbin, P. (2012) *Reserve Requirements for Price and Financial Stability: When Are They Effective?* International Journal of Central Banking, Vol. 8, pp. 65–114.

Glocker, C., and Towbin. P. (2015) *Reserve requirements as a macroprudential instrument–Empirical evidence from Brazil*, Journal of Macroeconomics, Vol. 44, pp. 158–76.

Gourinchias, P.O., and Obstfeld, M. (2012) *Stories of the Twentieth Century for the Twenty-First*, American Economic Journal: Macroeconomics, Vol. 4, pp. 226-265

Greenspan, A. (2002) *Economic Volatility*, Federal Reserve Bank of Kansas City, Jackson Hole Wyoming. 30 August 2002.

Grosse, R. (2004) *The challenges of globalization for emerging market firms*, Latin American Business Review, Vol. 4, pp. 1–21.

Herrera, H. V., Betancourt, Y. R., Varela, C., and Rodríguez, N. (2010) Effects of reserve requirements in an inflation targeting regime: The case of Colombia, BIS Papers Vol. 54, Bank for International Settlement, Basel.

International Monetary Fund. (2013-a). *Unconventional Monetary Policies—Recent Experience and Prospects.* [Online], Available at: http://www.imf.org/external/np/pp/eng/2013/041813a.pdf (accessed on 04 October 2021)

International Monetary Fund. (2013-b). *Unconventional Monetary Policies—Recent Experience and Prospects.* [Online], Available at: http://www.imf.org/external/np/pp/eng/2013/041813.pdf (accessed on 04 October 2021)

International Monetary Fund. (2013-c). *Global Impact and Challenges of Unconventional Monetary Policies.* [Online], Available at: http://www.imf.org/external/np/pp/eng/2013/090313.pdf (accessed on 04 October

2021).

Kahou, M. E., and Lehar, A. (2017) *Macroprudential policy: A review*. Journal of Financial Stability, Vol. 29, pp. 92–105.

Kannan, P., Rabanal, P. and Scott, A. (2009) *Monetary and Macroprudential Policy Rules in a Model with House Price Booms*, IMF working paper no. 09/251, Research Department, International Monetary Fund, Washington DC.

Kara, A.H. (2012) *Monetary Policy in Turkey after the Global Crisis*. Working Paper no. 12/17. Research and Monetary Policy Department Report, Central Bank of Republic of Turkey, Ankara.

Kara, A.H. (2015) *Interest Rate Corridor and the Monetary Policy Stance*. Working Paper No. 1513, Research and Monetary Policy Department, Central Bank of the Republic of Turkey, Ankara.

Kashyap, A. K., and Stein, J. C. (2012) *The optimal conduct of monetary policy with interest on reserves.* American Economic Journal: Macroeconomics, Vol. 4, pp. 266–82.

Küçük, H., Özlü, P., Talaslı, A., Ünalmış, D., and Yüksel, C. (2016) *Interest Rate Corridor, Liquidity Management, and the Overnight Spread*, Contemporary Economic Policy, Vol. 34, pp. 746–761.

Lambertini, L., Mendicino, C. and Punzi, M.T. (2013) *Leaning Against Boom-Bust Cycles in Credit and Housing Prices,* Journal of Economic Dynamics and Control, Vol. 37, pp. 1500-1522.

Lane, P. R. (2013) *Financial globalisation and the crisis.* Open Economies Review, Vol. 24, pp. 555–580.

Lim, C. H., Costa, A., Columba, F., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., and Wu, X. (2011) *Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences*. IMF Working Papers no 2011(238), International Monetary Fund. Washington, DC.

Lombardi, D., and Siklos, P. L. (2016) *Benchmarking macroprudential policies: An initial assessment.* Journal of Financial Stability, Vol. 27, pp. 35–49.

Lubis, A., Alexiou, C., and Nellis, J. G. (2021) *Monetary and macroprudential policies in the presence of external shocks: Evidence from an emerging economy.* Journal of Economic Studies.

Martin, C., and Milas, C. (2012) *Quantitative easing: A sceptical survey*. Oxford Review of Economic Policy, Vol. 28, pp. 750–64.

Martin, P., and Rey, H. (2006) *Globalization and emerging markets: With or without crash?* American Economic Review, Vol. 96, pp. 1631–51.

Mendoza, E. G. (2006) *Lessons from the debt-deflation theory of sudden stops.* American Economic Review, Vol. 96, pp. 411–416.

Mendoza, E. G., and Terrones, M. E. (2008) *An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data.* No. w14049. National Bureau of Economic Research. Cambridge.

Mester, L. J. (2017). *The nexus of macroprudential supervision, monetary policy, and financial stability.* Journal of Financial Stability, Vol. 30, pp. 177–180.

Mishkin, F. S. (1999) *Lessons from the Asian crisis.* Journal of International Money and Finance, Vol. 18, pp. 709–723.

Mishkin, F. S. (2001) *Financial Policies and the Prevention of Financial Crises in Emerging Market Economics.* No. 2683. World Bank Publications. Washington, DC.

Mishkin, F. S. (2010) Monetary Policy Strategy: Lessons from the Crises. Workin paper no. 16755, National Bureu of Economic Research, Cambridge.

Mountford, A., and Uhlig, H. (2009) *What are the effects of fiscal policy shocks?* Journal of Applied Econometrics, Vol. 24, pp. 960–992.

Obstfeld, M. (2004) *Globalization, Macroeconomic Performance, and the Exchange Rates of Emerging Economies*. No. w10849. National Bureau of Economic Research, Cambridge.

Oduncu, A., Akçelik, Y., and Ermisoglu, E. (2013) *Reserve Options Mechanism and FX Volatility*. Working Paper No: 13/03. Research and Monetary Policy Department, Central Bank of the Republic of Turkey, Ankara.

Özatay, F. (2012) *Para politikasında yeni arayışlar.* Iktisat Isletme ve Finans, Vol. 27, pp. 51–75.

Papadamou, S., Siriopoulos, C., and Kyriazis, N. A. (2020). *A survey of empirical findings on unconventional central bank policies.* Journal of Economic Studies, Vol. 47, pp. 1533–1577.

Rawdanowicz, L. 2010. *The 2008–2009 Crisis in Turkey: Performance, Policy Responses and Challenges for Sustaining the Recovery*. OECD Economic Department Working Papers, no. 819. Organisation for Economic Co-operation and Development, Paris.

Rojas, D., Carlos, V., and Guillermo, V. (2020). *The Macroeconomic Effects of Macroprudential Policy: Evidence from A Narrative Approach*. NBER Working

Papers no. 27687. National Bureau of Economic Research, Cambridge.

Sahin, A., Dogan, B., and Berument, M. H. (2015) *Effectiveness of the reserve option mechanism as a macroeconomic prudential tool: Evidence from Turkey*. Applied Economics, Vol. 47, pp. 6075–6087.

Sims, C. A. (1980) *Macroeconomics and Reality.* Econometrica: Journal of the Econometric Society, Vol. 48, pp. 1–48.

Sims, C. A. (1992) *Interpreting the macroeconomic time series facts: The effects of monetary policy.* European Economic Review, Vol. 36, pp. 975–1000.

Sims, C.A., Stock, J.H., and Watson, M.W. (1990) *Inference in Linear Time Series Models with Some Unit Roots.* Econometrica, Vol. 58, pp. 113–144.

Taylor, J.B. (1993) *Discretion versus Policy Rules in Practice,* Carnegie- Rochester Conference Series on Public Policy, Vol. 39, pp.195-214.

Thornton, D. L. (2017) *Effectiveness of QE: An assessment of event-study evidence.* Journal of Macroeconomics, Vol. 52, pp. 56–74.

Tovar, C. E., Garcia-Escribano, M., Martin, M. V., and Kramer, C. F. (2012) *Credit Growth and the Effectiveness of Reserve Requirements and Other Macroprudential Instruments in Latin America*. IMF Working Papers No. 142. International Monetary Fund, Washington DC.

Uhlig, H. (2005) *What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure*. Journal of Monetary Economics, Vol. 52, pp. 381–419.

Unsal, F. (2011) *Capital Flows and Financial Stability: Monetary Policy and Macroprudential Responses*, IMF Working Papers No. 189. International Monetary Fund, Washington DC.

Varlık, S., and Berument, M. H., (2016) *Credit channel and capital flows: A macroprudential policy tool? Evidence from Turkey*. Journal of Macroeconomics Vol. 16, pp.145–70.

Varlık, S., and Berument, M. H. (2017) *Multiple policy interest rates and economic performance in a multiple monetary-policy-tool environment.* International Review of Economics & Finance, Vol. 52, pp. 107–126.

White, W.R. (2009) Should Monetary Policy "Lean or Clean", Working Paper No.34, Federal Reserve Bank of Dallas, Teksas.

APPENDICES

Appendix A. Data Definitions, Diagnostic Tests and Estimation Results

Table 6. Data definitions and sources.

Variable	Definition	Transformation	Source
U	Unemployment, all persons (ages 15 and over).	Seasonally adjusted	TurkStat
CPI_D	CPI_D, excluding unprocessed food, alcoholic beverages and tobacco.	Seasonally adjusted	TurkStat
CA	Current account, balance of payments, million USD.	Seasonally adjusted	CBRT
SPRD	The difference between the commercial loan rate (with less than three-months maturity) and the deposit rate (with maturities up to three months), averaged, monthly.		CBRT
RR	Required Reserve Rates	We take the weighted average of the reserve requirements across maturities of liabilities subject to the reserve requirement and compute the cost-effective reserve requirement ratio during the implementation period of ROM. For a detailed explanation see (Alper et al. 2014).	CBRT

Table 6. Data definitions and sources (contd.)

ON	BIST overnight rate, monthly-averaged.	After May 2010, the CBRT utilized both the overnight lending and the one-week repo auctions at varying amounts according to its policy stance and the BIST overnight rate fluctuated within the interest rate corridor (Küçük et al. 2016). So, in order to reflect the policy stance of the CBRT, we take the BIST overnight rate as the interest rate.	BIST
CRED	Claims on private sector.	Logged	CBRT
USD	USD/TRY exchange rate.		CBRT
RSRV	Banking reserves.	Logged	CBRT
FED	The federal funds rate for US monetary policy		FED
CP	Commodity price index		IMF
VIX	The CBOE's index of 1-month implied volatility of S&P 500 Index.		CBOE
IP	Industrial Production for EU		CBP Netherlands

Table 7. Unit Root Test.

	ADF[a]			PP[b]			KPSS[c]	
Variables	**No Intercept No Trend**	**Intercept**	**Intercept and Trend**	**No Intercept No Trend**	**Intercept**	**Intercept and Trend**	**Intercept**	**Intercept and Trend**
U	-0,138 (13)	-3,584** (12)	-3,575*** (12)	-0,296 (16)	-2,397 (11)	-2,479 (11)	0,207 (10)	0,199*** (10)
AU	-2,807** (12)			-9,386** (118)	-9,319** (118)	-11,051** (115)	0,083 (16)	0,041 (16)
CPI	7,281 (2)	5,259 (2)	2,318 (2)	10,055 (6)	7,152 (10)	3,174 (11)	1,607*** (10)	0,388*** (10)
Δ CPI	-1,991** (4)	-3,483** (4)	-9,918 (1)	-5,510** (6)	-6,945** (11)	-7,37** (23)	1,439 (6)	0,212 (5)
CA	-11,852** (0)	-11,819** (0)	-12,325** (0)	-11,990** (4)	-11,960** (4)	-12,320** (1)	0,648 (5)	0,058 (2)
Δ CA								
SPRD	-1,456 (0)	-3,183*** (1)	-3,913*** (1)	-1,527 (8)	-3,088*** (3)	-3,706*** (2)	0,784** (10)	0,117*** (9)
Δ SPRD	-11,659** (0)			-11,568** (8)			0,042 (6)	0,041 (6)
RR	-1,246 (1)	-1,868 (1)	-1,929 (1)	-1,271 (8)	-1,933 (8)	-1,965 (8)	0,302 (10)	0,290** (10)
Δ RR	-8,062** (0)	-8,041** (0)	-8,071** (0)	-8,150** (4)	-8,129** (4)	-8,158** (4)		0,038 (8)
ON	-0,739 (1)	-2,256 (1)	-2,267 (1)	-0,710 (8)	-2,069 (8)	-2,077 (8)	0,286 (10)	0,282** (10)
Δ ON	-6,848** (0)	-6,830** (0)	-6,839** (0)	-6,904** (1)	-6,886** (1)	-6,896** (1)		0,039 (8)
CRED	4,887 (2)	3,249 (2)	0,351 (2)	7,408 (6)	4,224 (6)	0,782 (6)	1,657** (10)	0,410** (10)
Δ CRED	-3,663** (2)	-6,386** (0)	-7,430** (1)	-5,261** (5)	-6,380** (5)	-6,999** (3)	0,871** (8)	0,070 (6)
USD	4,211 (2)	2,952 (2)	0,305 (2)	4,826 (8)	3,509 (9)	0,414 (8)	1,446** (10)	0,402** (10)
Δ USD	-6,236** (2)	-6,773** (2)	-11,536** (1)	-8,250** (2)	-8,070** (6)	-8,690** (11)	0,755** (1)	0,073 (8)
RSRV	0,911 (3)	0,056 (3)	-0,775 (3)	2,276 (6)	1,765 (6)	0,721 (6)	0,695 (10)	0,207 (10)
Δ RSRV	-4,694** (2)	-4,830** (2)	-5,090** (2)	-7,926** (6)	-8,006** (5)	-8,226** (5)		
FED	-2,370** (1)	-2,095 (1)	-1,811 (1)	-2,071** (8)	-1,790 (8)	-1,575 (8)	0,524 (10)	0,317** (10)
Δ FED		-6,939** (0)	-7,018** (0)		-6,810** (4)	-6,881** (5)		0,111 (8)
CP	-0,044 (6)	-12,342** (0)	-12,341** (0)	-0,330 (14)	-12,342** (0)	-12,343** (0)	0,105 (1)	0,088 (0)
Δ CP	-11,089** (5)			-57,160** (34)				
VIX	-1,577 (0)	-4,295** (0)	-4,357** (0)	-1,077 (11)	-4,272** (2)	-4,339** (2)	0,269 (9)	0,148 (9)
Δ VIX	-11,632** (1)			-17,179** (17)				
IP	-0,129 (2)	-2,713 (2)	-2,710 (2)	-0,085 (7)	-2,912 (3)	-2,908 (3)	0,155 (10)	0,148 (10)
Δ IP	-10,690** (1)	-10,659** (1)	-10,630** (1)	-10,773** (11)	-10,734** (11)	-10,695** (11)		

Notes:
** and *** indicates rejection of the null hypothesis at 1 percent and 5 percent respectively.
a Lag length is presented in brackets. Lag length is selected based on Schwartz information criteria when maximum lag length is 13.
b Bandwidth is in brackets and was chosen by Newey-West algorithm using Bartlett kernel.

Table 8. BVAR estimation results on selected macroeconomic variables.

	U				CPI			
	Coefficient *	**St.dev**	**Low. Bound**	**Upp. Bound**	**Coefficient ***	**St.dev**	**Low. Bound**	**Upp. Bound**
U_{t-1}	0.825	0.049	0.776	0.874	0.007	0.044	−0.036	0.051
CPI_{t-1}	−0.014	0.039	−0.053	0.024	0.577	0.073	0.504	0.649
CA_{t-1}	−0.000	0.000	−0.000	0.000	0.000	0.000	−0.000	0.000
$SPRD_{t-1}$	0.009	0.022	−0.013	0.031	−0.001	0.026	−0.027	0.024
RR_{t-1}	−0.01	0.016	−0.026	0.005	0.001	0.018	−0.017	0.019
ON_{t-1}	−0.021	0.013	−0.034	−0.008	−0.006	0.015	−0.021	0.009
$CRED_{t-1}$	0.164	0.426	−0.26	0.588	−0.018	0.49	−0.505	0.469
USD_{t-1}	−0.116	0.132	−0.247	0.015	−0.008	0.155	−0.162	0.146
$RSRV_{t-1}$	0.118	0.184	−0.065	0.301	0.028	0.213	−0.184	0.24
Intercept	0.711	2.493	−1.768	3.191	−0.265	2.896	−3.145	2.615
VIX_{t-1}	−0.001	0.007	−0.008	0.005	0.004	0.008	−0.004	0.011
IP_{t-1}	−0.006	0.032	−0.038	0.026	0.007	0.037	−0.03	0.044
FED_{t-1}	−0.356	0.253	−0.608	−0.104	0.217	0.284	−0.065	0.499
CP_{t-1}	0.004	0.009	−0.005	0.012	0.023	0.01	0.013	0.033
Trend	−0.024	0.032	−0.056	0.008	0.009	0.036	−0.027	0.045
$Trend^2$	0.000	0.000	0.000	0.000	−0.000	0.000	−0.000	0.000
Adj. R^2	0.863				0.287			

* Coefficients are posterior estimates.

Table 9. BVAR estimation results on selected financial variables.

	SPRD				USD			
	Coefficient *	**St.dev**	**Low. Bound**	**Upp. Bound**	**Coefficient ***	**St.dev**	**Low. Bound**	**Upp. Bound**
U_{t-1}	−0.114	0.069	−0.183	−0.045	0.005	0.012	−0.007	0.016
CPI_{t-1}	−0.010	0.071	−0.081	0.061	0.007	0.012	−0.005	0.020
CA_{t-1}	−0.000	0.000	−0.000	0.000	0.000	0.000	−0.000	0.000
$SPRD_{t-1}$	0.773	0.057	0.716	0.829	−0.004	0.007	−0.011	0.003
RR_{t-1}	0.018	0.029	−0.010	0.047	0.002	0.005	−0.003	0.007
ON_{t-1}	0.016	0.024	−0.008	0.004	−0.003	0.004	−0.007	0.001
$CRED_{t-1}$	−0.473	0.778	−1.246	0.300	−0.006	0.133	−0.138	0.126
USD_{t-1}	0.323	0.242	0.082	0.564	0.816	0.060	0.757	0.875
$RSRV_{t-1}$	0.395	0.337	0.060	0.730	0.049	0.058	−0.009	0.107
Intercept	−0.892	4.560	−5.427	3.642	−0.09	0.784	−0.870	0.689
VIX_{t-1}	−0.007	0.012	−0.019	0.004	0.001	0.002	−0.001	0.003
IP_{t-1}	−0.058	0.059	−0.116	0.000	0.011	0.010	0.001	0.021
FED_{t-1}	0.143	0.455	−0.310	0.596	0.031	0.076	−0.045	0.107
CP_{t-1}	0.021	0.016	0.006	0.037	−0.001	0.003	−0.004	0.001
Trend	0.072	0.059	0.013	0.130	−0.002	0.010	−0.012	0.008
$Trend^2$	−0.000	0.000	−0.001	−0.000	0.000	0.000	−0.000	0.000
Adj. R^2	0.834				0.99			

* Coefficients are posterior estimates.

Appendix B. Endogenous Variables

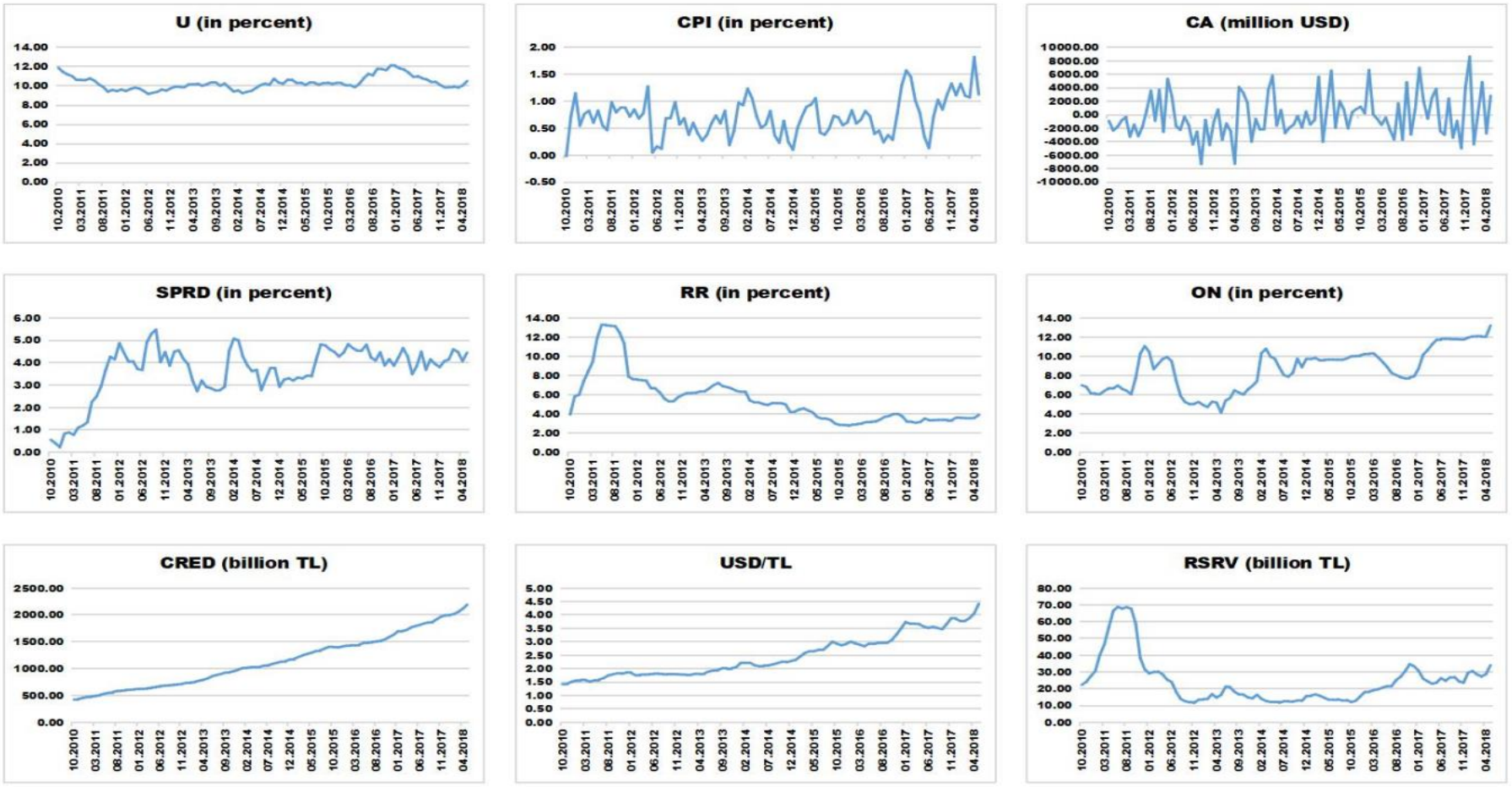


Figure 16. Endogenous variables used in the baseline model.

Appendix C. Robustnest Test Results

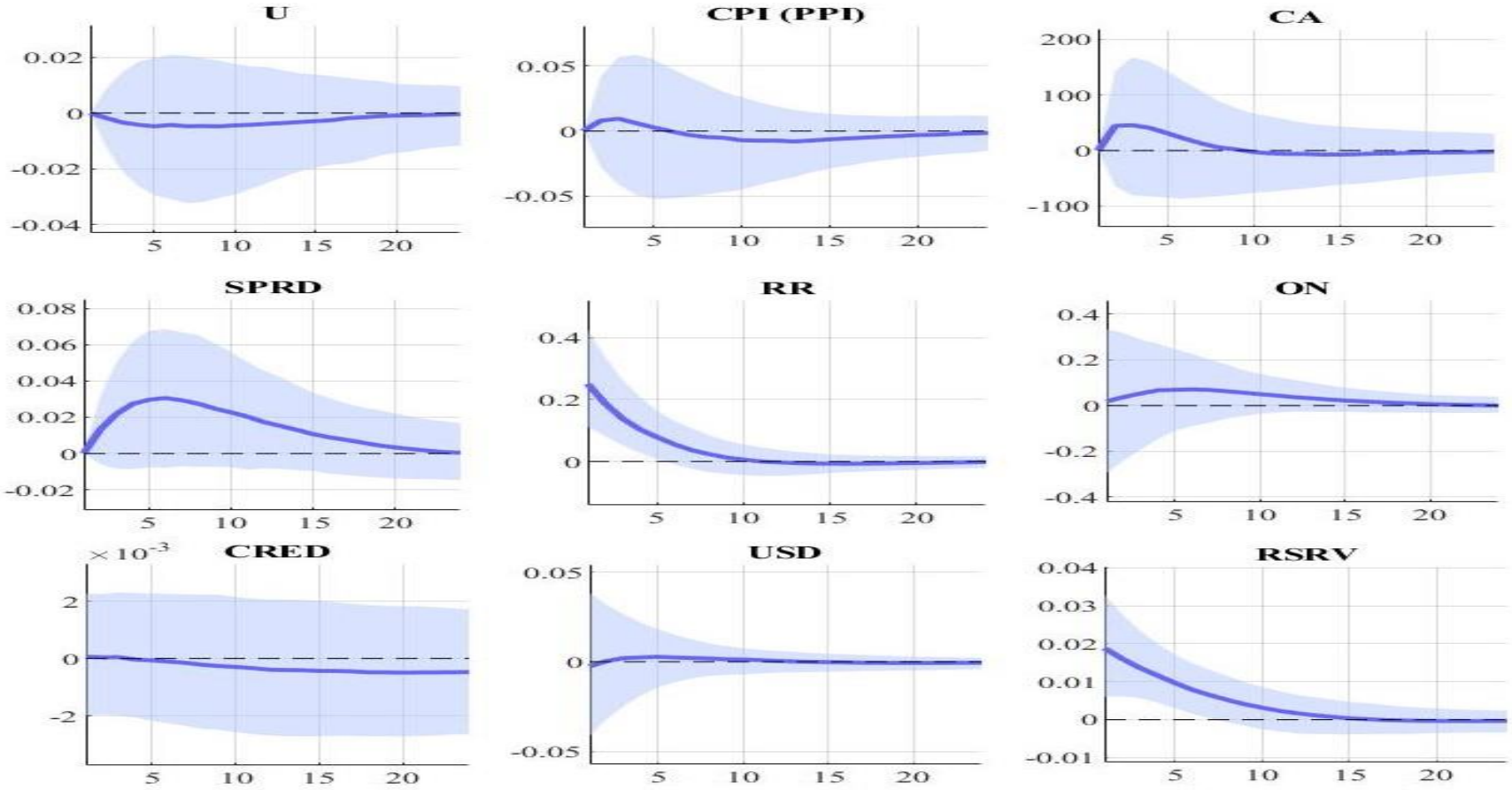


Figure 17. Responses to the reserve requirement shock. Robustness check CPI (PPI).

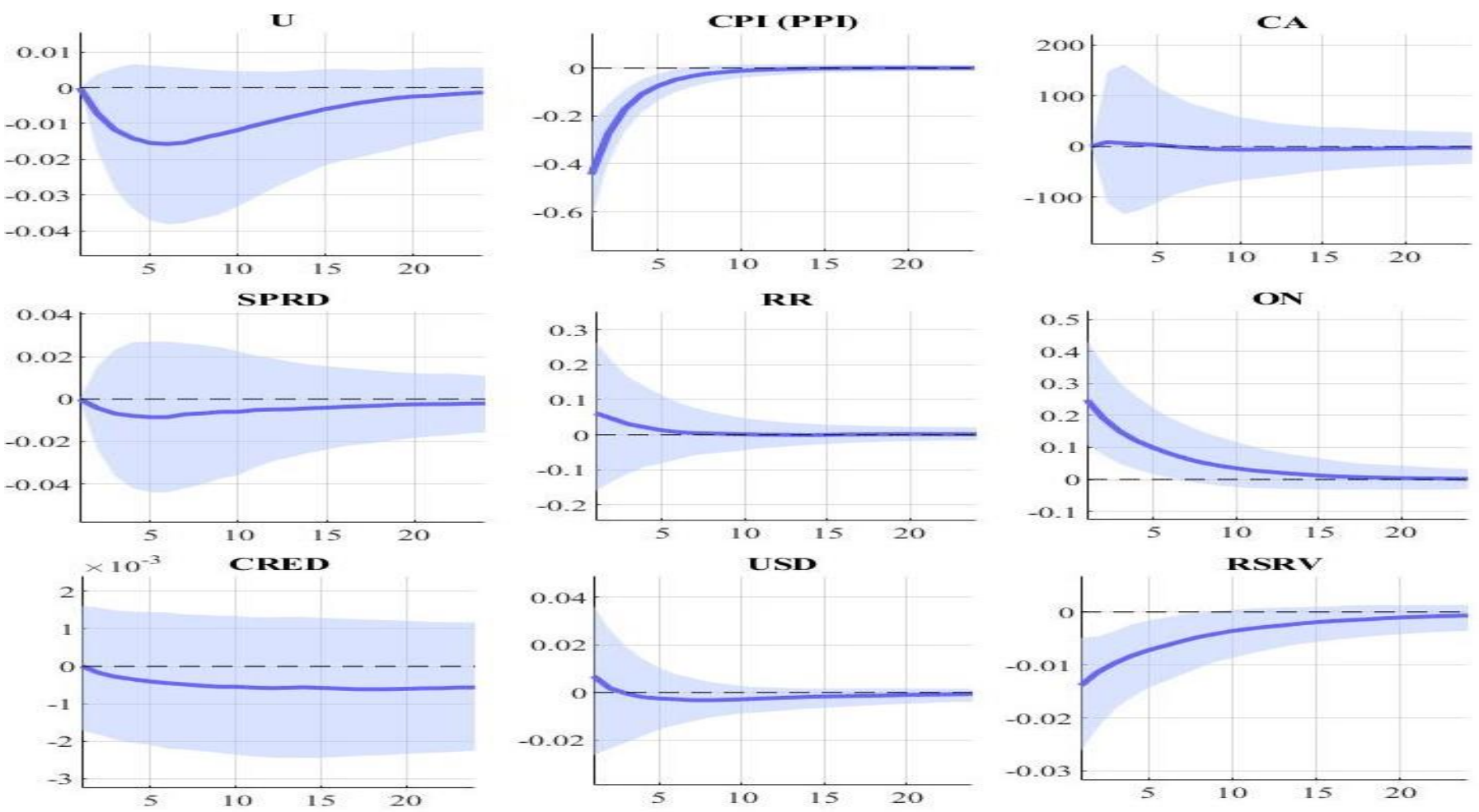


Figure 18. Responses to interest rate shock. Robustness check CPI (PPI).

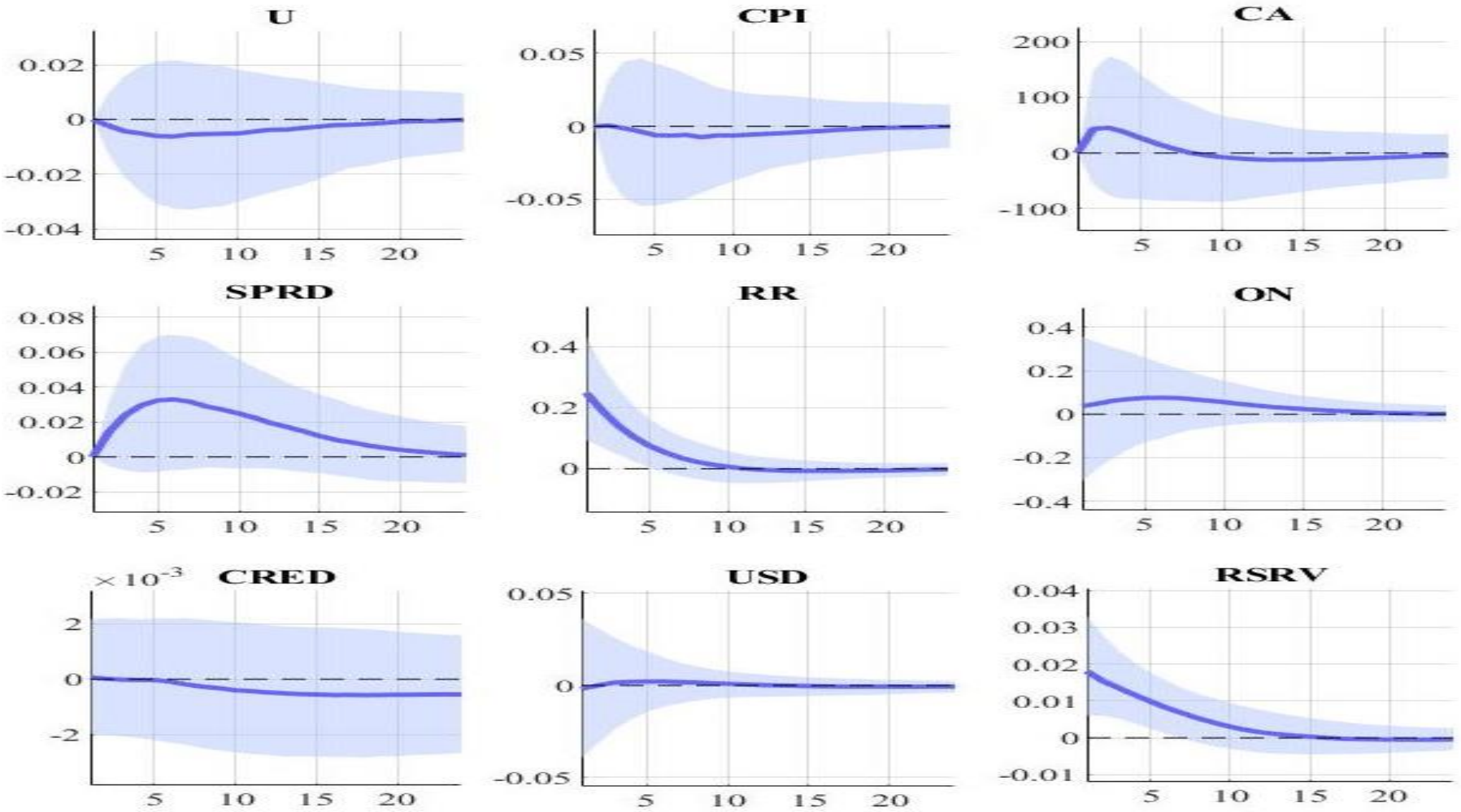


Figure 19. Responses to the reserve requirement shock. Robustness check CPI

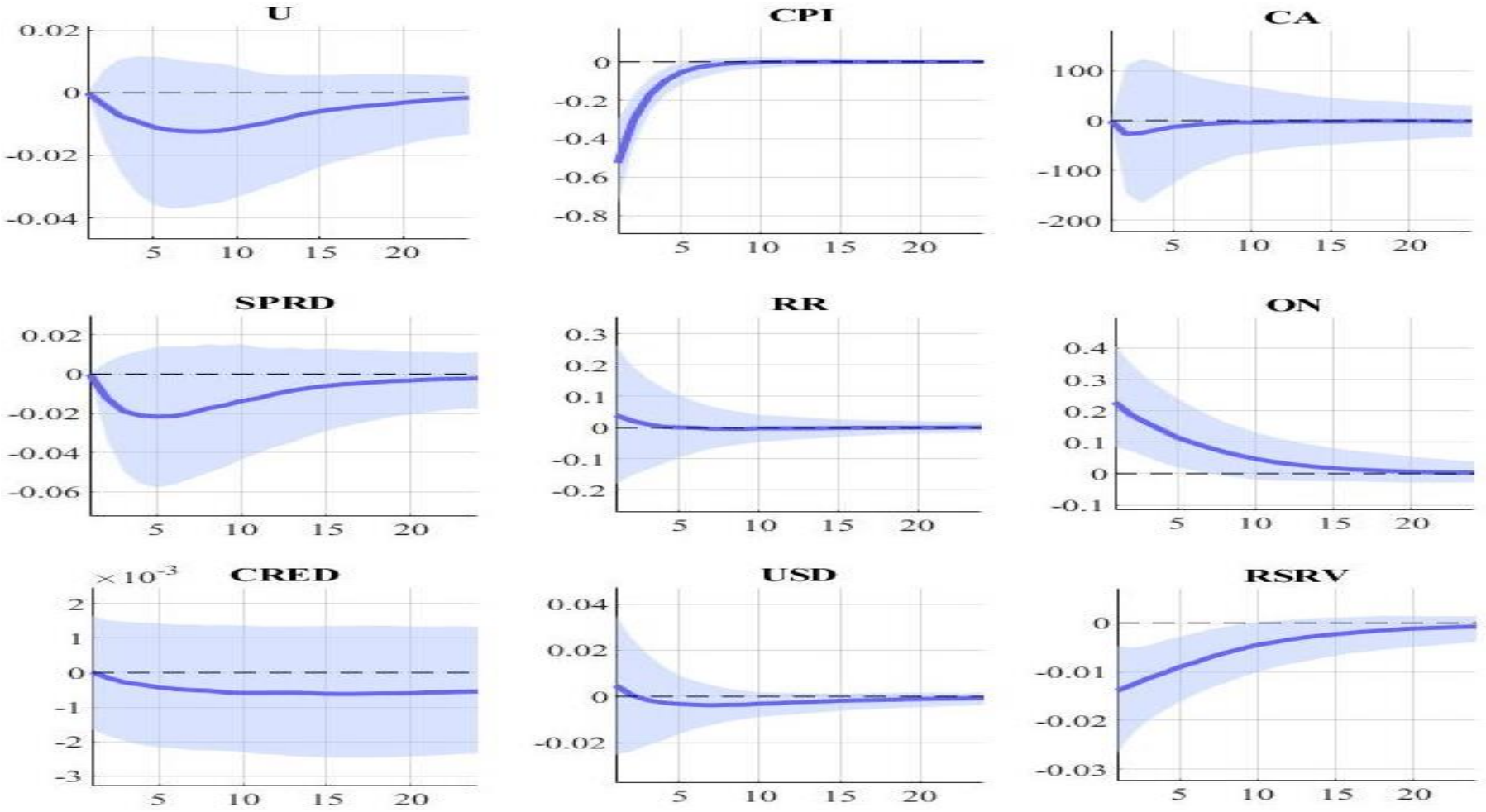


Figure 20. Responses to interest rate shock. Robustness check CPI.

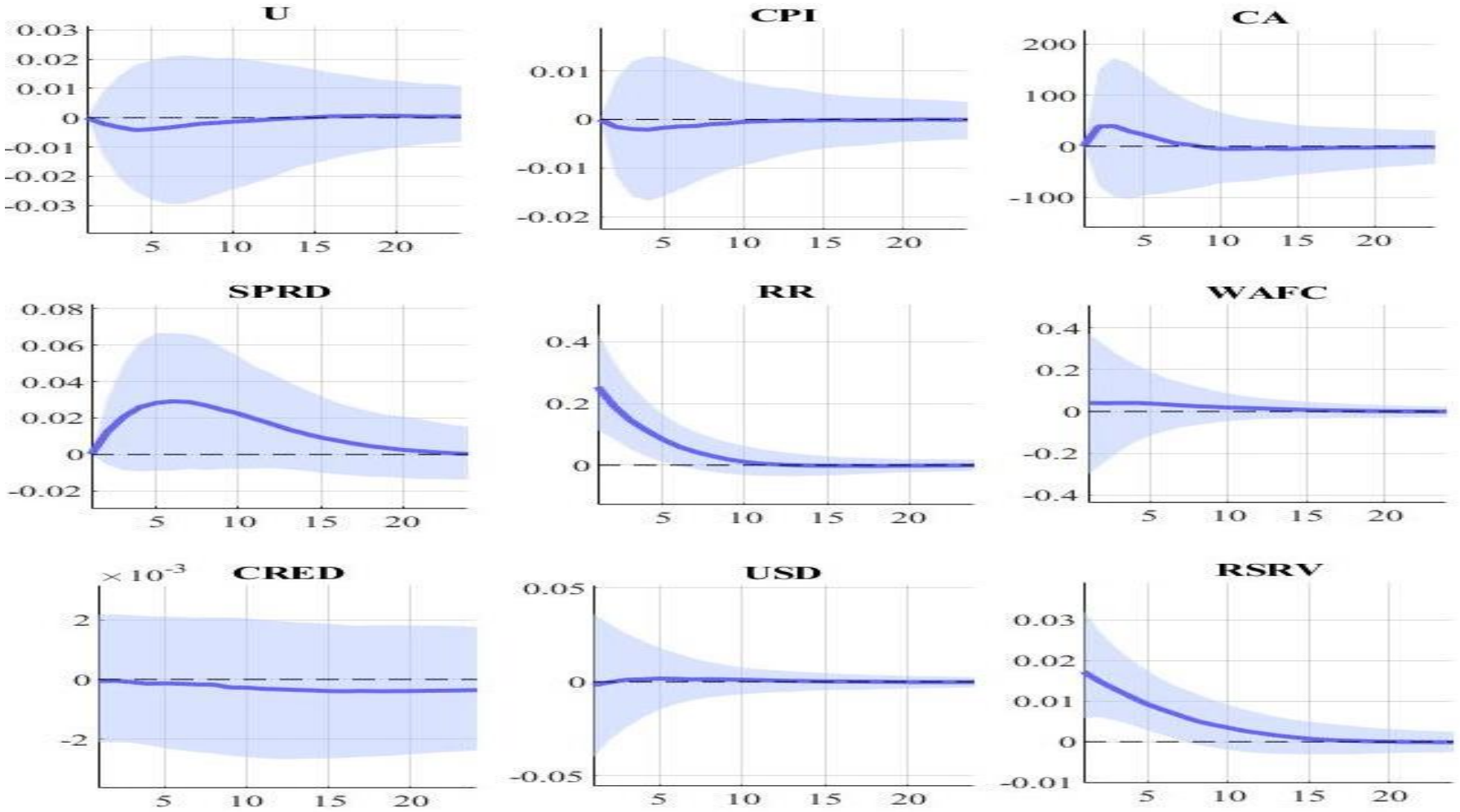


Figure 21. Responses to the reserve requirement shock. Robustness check WAFC

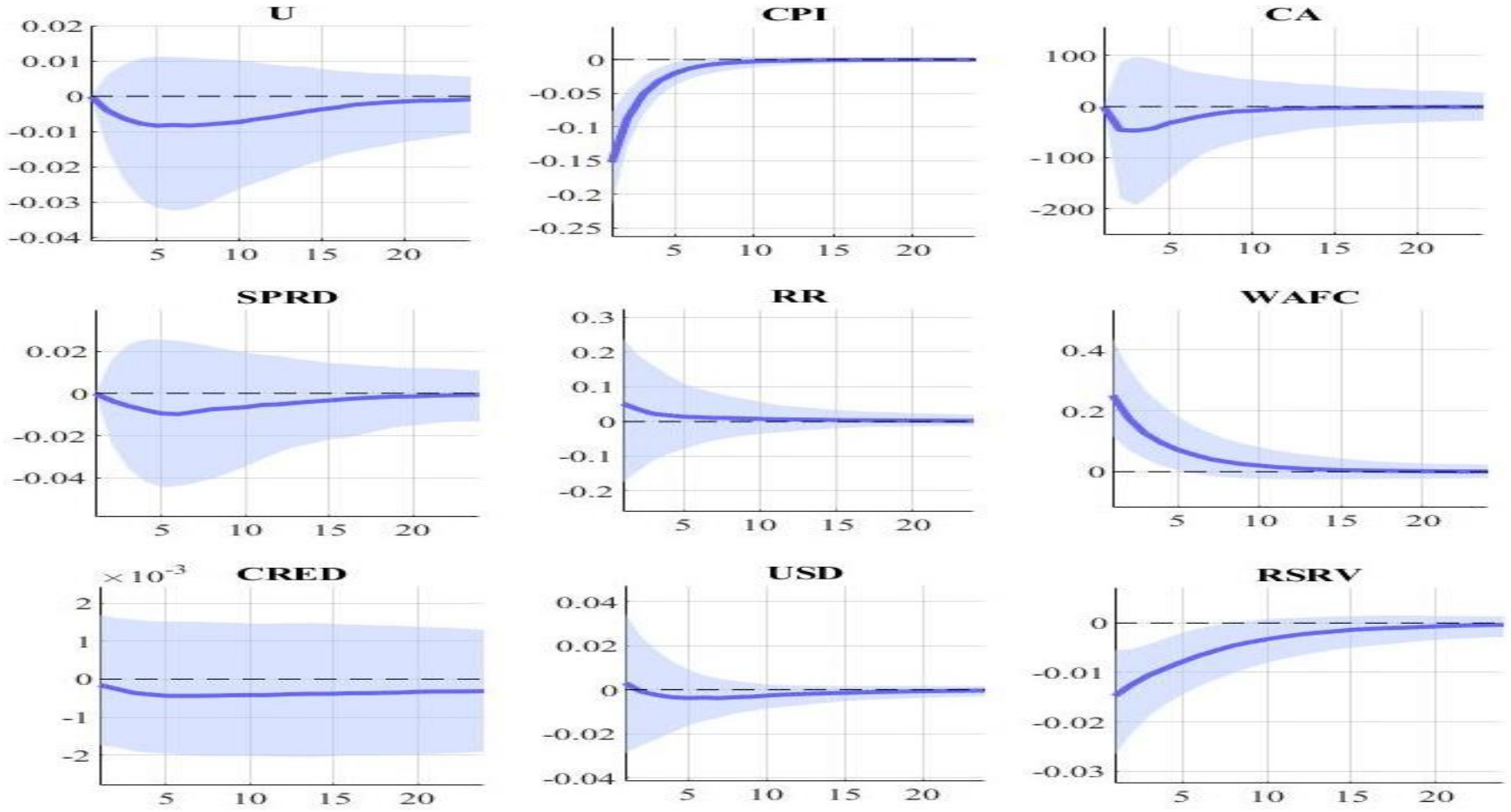


Figure 22. Responses to the interest rate shock. Robustness check WAFC

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