Monetary Policy Transmission in Sri Lanka

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Abstract

Sri Lanka's monetary policy has evolved differently during and after the three-decade-long ethnic conflict. This paper empirically investigates the effects of monetary policy shocks on the Sri Lankan economy and the intertwined relationship between bank credit and other macroeconomic variables using an SVAR model. The main empirical findings are as follows: (1) effects of a contractionary monetary policy shock on output and inflation are swifter; (2) the credit and exchange rate channels play a nontrivial role in monetary policy transmission; (3) bank credit shock has a transitory effect on output growth and inflation; (4) the effects of monetary policy shock are more prominent and persistent in the post-conflict period than in the conflict period because of the improved credit and exchange rate channels; and (5) external shocks are an important source of macroeconomic fluctuation in Sri Lanka.

LEGENDS

— Writing style / grammar suggestions

— Technical matters

— Substantive / economic questions / suggestions / issues

Reader: T. Kam

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1. Introduction

Monetary policy is a popular stabilisation tool commonly used to achieve price and economic stability. A central bank's monetary policy actions affect the real economy through various transmission channels such as interest rate, exchange rate, bank credit and asset price channels (Bernanke & Blinder 1992; Boivin et al. 2010). Monetary policy changes are propagated through the various financial markets; thus, a better understanding and assessment of the monetary policy transmission is necessary to manage the economy effectively. In this paper, we focus on the monetary policy transmission in Sri Lanka. Since the end of the three-decade-long internal arm conflict in 2009, Sri Lanka has heavily relied on monetary policy to promote output growth. In particular, the Central Bank of Sri Lanka (CBSL) has been using an accommodative monetary policy to support economic growth given the subdued demand-push inflationary pressure. It has also adopted an active market-oriented monetary policy framework and communication strategy to improve monetary policy transmission. Bank lending has increased significantly since 2009, and market forces have determined the exchange rate more freely. However, monetary policy transmission has displayed a slow pass through in recent years. The market lending rates exhibit a downward rigidity in response to policy rate cuts. Moreover, the link between major macroeconomic variables such as money and inflation, money and economic growth, inflation, and economic growth has become weaker (Jegajeevan 2019); as a result, the single-digit inflation episode that prevails since 2009 has failed to provide the impetus for economic growth.

Against this background, this study aims to explore the monetary policy transmission in Sri Lanka by empirically investigating the following questions: (i) How does monetary policy affect the real economy, and what role do credit and exchange rate channels play in the monetary policy transmission? (ii) How have the post-war financial sector development and economic dynamic changes impacted the monetary policy transmission in Sri Lanka? and (iii) How do credit shocks affect the Sri Lankan economy?

A large number of studies have investigated the effects of monetary policy shocks in advanced and developing countries. However, the impact of monetary policy shocks on the real economy is still a contentious issue. The extant literature shows that monetary policy transmission differs between advanced and developing countries mainly due to different financial market conditions. Monetary policy changes affect the real economy by changing the interest rate, asset prices and exchange rate; hence, the effectiveness of monetary policy depends on the functioning of different financial markets.

Many studies have examined monetary policy transmission in developing countries directly comparable to the Sri Lankan context. For example, Kubo (2008) finds that monetary policy operates through a dominant credit channel in Thailand. Aleem (2010) concludes that the bank lending channel plays a crucial role in transmitting monetary policy shocks to the real sector in India. Bhuiyan (2012) finds that interest rate and exchange rate channels play a dominant role in propagating monetary policy shocks in Bangladesh. Raghavan et al. (2012) conclude that the Asian financial crisis and the subsequent policy changes in the exchange rate regime have affected Malaysian monetary policy transmission. Their findings indicate that the exchange rate, credit and asset price channels play a significant role in transmitting monetary policy shock in the pre-crisis period. Studies have found the asset price channel plays a crucial role in the post-crisis period. Wulandari (2012) finds an effective credit channel and interest rate channel in transmitting monetary policy shocks to Indonesia's real sector. Afrin (2017) concludes that the central bank's intervention in the foreign exchange market makes the exchange rate channel less effective, and

Q1. Claimed but not substantiated.

- references?
- How do these regimes differ?
- Why?

Q2. What is the difference between "credit channel" and "bank lending channel"?

And "interest rate" channel?

credit shock has a short-lived impact on output and inflation in Bangladesh. Anwar and Nguyen (2018) show that monetary policy strongly influences Vietnam's output, while Nguyen et al. (2019) conclude that interest rate is an effective tool to stabilise inflation in Vietnam and broad money is a useful tool to boost output and credit growth. Vo and Nguyen (2017) find that monetary policy operates through the interest rate channel but not through the exchange rate channel or asset price channel in Vietnam.

Earlier studies on Sri Lanka's monetary policy transmission includes Amarasekara (2008), Ghazanchyan (2014), Perera (2016) and Vinayagathasan (2013). Amarasekara (2008) finds that contractionary monetary policy shock decreases output and inflation while causing exchange rates to appreciate using a VAR model. Vinayagathasan (2013) estimates an SVAR model similar to Kim and Roubini (2000) to investigate monetary policy transmission. His findings suggest that the interest rate, as a monetary policy instrument, plays a significant role in explaining the fluctuation of macroeconomic variables. Ghazanchyan (2014) employs several VAR models to show that interest rate and bank lending channels effectively transmit the monetary policy shocks. Perera (2016) argues that monetary policy operates through the bank credit, exchange rate and asset price channels. However, all these studies suffer from empirical puzzles such as price and exchange rate puzzles. These puzzling results indicate that the models could be misspecified and fail to correctly identify the monetary policy reaction function or monetary policy shock (Christiano et al. 1999; Zha 1999).

Our paper deviates from these studies in several important aspects. Unlike previous studies, we use an empirical model that accounts for the features of small open economies to reflect the Sri Lankan economy's structure. Furthermore, our study investigates the strength of the credit channel[1] and the effects of credit shock on the real economy. None of the previous studies has examined the intertwined relationships between bank credit and other key macroeconomic variables. Finally, we focus on an extended period of post-conflict. This study is the first to investigate how monetary policy transmission has evolved after the end of the conflict using an extended post-war sample period. Examining the post-war scenario is crucial to policymakers in Sri Lanka as the Central Bank has focused more on an accommodative monetary policy to support economic growth in the post-conflict period.

As such, the contributions of our paper are fourfold. First, this paper adds new empirical evidence to the limited monetary policy and credit channel literature on emerging and developing economies by examining the monetary policy transmission in Sri Lanka. Second, the small open economy SVAR model estimated in this study provides reliable empirical evidence on the impacts of monetary policy transmission and the strength of a middle-income country's credit and exchange rate channels. Third, the recursive SVAR model and the conventional ordering (Cholesky factorization) of the variables used in this study are free from the empirical puzzles such as price and exchange rate puzzles commonly found in emerging country studies. In the context of developing economies, assuming a Cholesky factorisation may be more realistic as the macroeconomic variables tend to respond immediately to the changes in the internal and external environment. Finally, we include foreign exchange reserves in the model[2]. In a small open

[1] Past studies have established the importance of credit channel in the monetary policy transmission, for example, Bernanke (1990), Bernanke and Blinder (1992) and Kashyap et al. (1992) for the USA, Dale and Haldane (1995) for UK, Fountas and Papagapitos (2001) for European Union, Safaei and Cameron (2003) for Canada and Suzuki (2004a) Japan. Given the dominance of the banking sector in the financial market, bank lending is likely to be a dominant monetary policy channel in developing countries (Montiel et al. 2010). Bank credit has been a major source of financing for household and non-financial firms in Sri Lanka. In particular, in the post-conflict period, Sri Lanka's banking sector and bank credit have recorded significant growth.

[2] Kim and Lim (2018) include the foreign exchange reserves in the SVAR models estimated for advanced economies (United Kingdom, Canada, Sweden, and Australia) to investigate the effects of monetary policy shocks on exchange rate.

Footnote after punctuation ".”

economy like Sri Lanka, the central bank uses a separate foreign exchange intervention mechanism (foreign exchange purchase and sales) to stabilise the exchange rates. Therefore, foreign exchange intervention is likely to affect the exchange rate movements in these economies. Thus, the inclusion of foreign exchange reserves is appropriate as neglecting it may result in model misspecification. More importantly, the inclusion of foreign exchange helps resolve the exchange rate puzzle.

Q3

Obtained results show that the monetary policy transmission works faster, with most of the effects of a contractionary monetary policy shock on output and inflation disappearing within six quarters. The credit and exchange rate channels appear to play a nontrivial role in monetary policy transmission as credit and exchange rate responses are more persistent than other variables. The impacts of a positive credit shock on output growth and inflation are short-lived. The Central Bank reduces the interest rate slightly since the credit boom does not produce the expected output growth in response to a credit shock. External shocks are an important source of macroeconomic fluctuation in Sri Lanka, and the monetary policy appears to be sensitive to external sector shocks. Moreover, results indicate that the monetary policy transmission has improved after 2009, as the impacts of monetary policy shock are larger and more persistent in the post-conflict period than in the conflict period.

The remainder of the paper is organised as follows. Section 2 provides a brief overview of Sri Lanka's banking sector and monetary policy framework. Section 3 presents empirical methodology. Section 4 reports the empirical results. Section 5 discusses the robustness of the results. Section 6 concludes.

2. Banking sector and monetary policy framework in Sri Lanka

2.1 The banking sector

As in other emerging economies, the financial market is primarily dominated by the banking sector in Sri Lanka. The banking sector accounts for around 70 per cent of the financial sector asset in Sri Lanka. Although the banking sector reforms started back in the late 1970s with the introduction of liberal economic policies, the banking sector in Sri Lanka was dominated by state-owned banks till early 2000. The Central Bank created a level playing field for both state-owned and private banks by relaxing several restrictions on the banking sector in early 2000. As a result, the market share of the private banks exceeded that of the state-owned banks by 2002 (Thilakaweera 2016). After the end of the conflict in the mid of 2009, the banking sector recorded a significant expansion due to the favourable economic environment and the revival of economic activities in the two war-affected provinces (Northern and Eastern Provinces). Many bank branches were established in the war-affected regions after the conflict; the total number of bank branches increased from 2493 in 2008 to 3,619 at the end of 2020. The expansion of the banking sector has contributed to a significant increase in bank savings and credit availability.

Bank credit to the private sector has increased from 23% of GDP in 2010 to 38% in 2019. The growth in the bank credit can be regarded as a significant increase because this ratio had not changed considerably before the end of the conflict (private credit to GDP ratio had remained close to 25 per cent). Moreover, gross domestic credit granted by the banking sector also recorded a steep rise from 35% of GDP in 2010 to 62% in 2019. Surprisingly, the credit growth has not resulted in a surge in non-performing loans. The non-performing loans dropped from 13.6 per cent

Q3 "works faster"

Faster than what / when?

Tell the reader your subsample experiments from the outset.

(outline the main exercise of section 4.6 in intro)

in 2000 to 4.7 per cent in 2019. The deposits also registered a faster growth after the end of the armed conflict (see Table 1 in the Appendix).

These developments in the banking sector are likely to have significantly impacted the monetary policy transmission in Sri Lanka. Thilakaweera (2016) finds that banking sector efficiency has improved considerably in the post-conflict period. On the other hand, the presence of excess liquidity in the banking sector and the rise in the government security holdings in the Commercial Bank's asset composition have hindered the monetary policy pass-through (Ghazanchyan 2014). However, no previous studies have investigated the intertwined relationship between Sri Lanka's monetary policy, bank credit, and the real economy.

2.2 The monetary policy framework

Sri Lanka's monetary policy framework has evolved from a currency board system to a flexible inflation targeting framework. The Central Bank of Sri Lanka (CBSL) was established in 1950 under the Monetary Law Act, No. 58 of 1949. At its inception, the CBSL was entrusted with stabilising the domestic and external value of the rupee and promoting economic activities (Amarasekara 2008; Perera 2016). Sri Lanka's monetary policy framework was primarily based on maintaining a fixed exchange rate until the economic liberalisation policies were introduced in 1977 (Weerasinghe, 2018). The CBSL mainly relied on direct control instruments to implement the monetary policy during this period (Perera 2016).

With the introduction of liberal economic policies in 1977, the Central Bank abandoned the fixed exchange rate regime and moved towards a more market-based exchange rate, which was a welcomed move at that time. However, without a tool to anchor inflation expectation, the Central Bank had to face an upheaval task of managing higher inflation triggered by soaring fiscal deficit and external deficit (Weerasinghe 2017). Thus, to contain inflation and inflation expectation, the Central Bank adopted a monetary targeting framework in the early 1980s. To be consistent with the new framework, the Central Bank introduced market based monetary policy instruments. For example, in the early 1990s, the Central Bank introduced repurchase rate and reverse repurchase rate to guide the market interest rates. Later, the Central Bank used these two interest rates to form a policy interest rate corridor to signal its monetary policy stance.

The global and domestic developments in the financial sector and monetary policy and the terrorist attack on the CBSL head office building in 1996 prompted the CBSL Modernization Project (Amarasekara et al. 2018). This modernisation project paved the way for establishing a Monetary Policy Committee (MPC) in 2001 to strengthen monetary policy analysis, introducing a floating exchange rate and an active open market system. Moreover, in response to the changing domestic and global economic environment, the Monetary Law Act was amended in 2002. Under this legislative change, the objectives of CBSL were streamlined to two core objectives: achieving economic and price stability and financial system stability.

The relationship between the price stability and the nominal anchor of monetary aggregate has significantly weakened since 2009 (Weerasinghe 2017). Therefore, Sri Lanka's monetary policy framework is currently transitioning towards a flexible inflation targeting framework. Accordingly, at present, the CBSL conducts its monetary policy within an enhanced framework, including monetary aggregate targeting and flexible inflation targeting as an interim arrangement. Under this new arrangement, the CBSL targets maintaining inflation at mid-single digits over the medium term. CBSL uses broad money aggregates as indicative intermediate variable and average weighted call money rate as the operating target.

Weerakoon, Kumar, Dime (ADB, South Asia WP No. 63, 2019): IMF SBA (2001) – CBSL to move to a "floating ER" rgme from Jan 2001.

The CBSL's monetary policy formulation has also evolved. The step towards a more transparent and forward-looking policy formulation started with the establishment of the MPC. In the mid-2000s, forward-looking inputs were introduced to the MPC. In recent times the CBSL has developed structural models for forecasting and monetary policy analysis, which provide forward-looking guidance to achieve medium-term inflation targets while stabilising real output. The CBSL also formed a Monetary Policy Consultative Committee comprising representatives from the private sector, professionals and academics to obtain private sector views to support monetary policy formulation. In addition, the Central Bank introduced different levels of technical meetings to upgrade the monetary policy formulation process in 2017.

The Central Bank has enhanced the monetary policy decision-making process by improving its modelling capacity with technical assistance from the International Monetary Fund (IMF). Furthermore, the CBSL has adopted active communication by issuing regular press releases and conducting press conferences on monetary policy decisions to improve the transparency regarding the monetary policy stance. These modifications to the monetary policy formulation are likely to influence the monetary policy transmission in Sri Lanka (Central Bank of Sri Lanka 2018).

3. Methodology

3.1 The open economy SVAR model

Unlike previous studies, this study uses an open economy SVAR model that consists of external and domestic sectors to examine the monetary policy transmission in Sri Lanka.[3] The structural representation of the VAR model of order p is

$$A_0 y_t = C + \sum_{i=1}^{p} A_1 y_{t-p} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

where y_t is a $n \times 1$ vector of endogenous macroeconomic variables, and A_0 is the $(n \times n)$ contemporaneous coefficient matrix, C represents $n \times 1$ vector of constant terms, A_i refers to the $(n \times n)$ autoregressive coefficient matrices and ε_t denotes $n \times 1$ vector of orthogonal structural shocks. Each of the shocks is serially uncorrelated across time, and any two different shocks in the system are also uncorrelated.[4]

In this study, y_t is (OP, FFR, FER, Y, INF, M1, INT, CR, RER)[5] where OP is the world oil price in terms of US dollar, FFR is the US Federal Fund rate, Y is the real GDP, INF is the inflation

[3] The inclusion of two blocks of sectors in a small open economy is consistent with previous SVAR studies (Brischetto & Voss 1999; Dungey & Pagan 2000, 2009; Kim & Roubini 2000). Several developing country studies also have adopted a similar assumption, for example, Afrin (2017) for Bangladesh, Anwar and Nguyen (2018) for Vietnam and Raghavan et al. (2012) for Malaysia.

[4] $Cov(\varepsilon_{it}, \varepsilon_{it-1}) = 0$ and $Cov(\varepsilon_{it}, \varepsilon_{jt-1}) = 0, where\ i \neq j$

[5] The world crude oil price and the US Federal Fund Rate represent the external block. In the monetary policy literature, oil price or commodity price is commonly included as a proxy to account for adverse supply shocks and expectations of future inflation to resolve the price puzzle (Christiano et al. 1998; Kim & Roubini 2000; Sims 1992). The inclusion of oil price is crucial since Sri Lanka is a net oil-importing country heavily dependent on imported petroleum products for energy. The US Federal Fund rate represents the foreign monetary policy. The US is the single largest destination for Sri Lanka's exports, accounting for 26 per cent of the total export in 2018 and 2019. Thus, fluctuations in US real GDP and changes in its monetary policy can influence the Sri Lankan economy. Therefore, the inclusion of the US economy, which represents the rest of the world, in the model is reasonable. Other studies that include US variables to account for the external sector in their SVAR models are Kim and Roubini (2000) for

avoid footnotes mid sentence !

measured by the quarterly change in the consumer price index, M1 is the narrow monetary aggregate, INT is the short-term interest rate (money market rate), RER is the real exchange rates expressed in units of Sri Lankan currency for one unit of US dollar (RER),[6] CR is the total loans to the private sector from commercial banks, and FER is the foreign exchange reserves excluding gold. Following Kim and Lim (2018), we include foreign exchange reserves because the central bank's foreign exchange interventions play an important role in the exchange rate movement in a small open economy.

The reduced form of the above model (1) can be expressed by multiplying both sides of the equation (1) with A_0^{-1}.

$$y_t = a_0 + \sum_{i}^{p} B_i\, y_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where $a_0 = CA_0^{-1}$, $B_i = A_0^{-1}A_i$, and $e_i = A_0^{-1}\varepsilon_i$ denoting the reduced form errors that are linear combinations of the structural errors ε_i. We can identify the structural disturbances of the model by imposing suitable restrictions on contemporaneous relationships.[7] This study applies a recursive causal ordering on the contemporaneous interaction (Cholesky factorization) as follows. This implies a lower-triangular A_0 matrix.

$$e_t = \begin{pmatrix} e_t^{OP} \\ e_t^{FFR} \\ e_t^{FER} \\ e_t^{Y} \\ e_t^{INF} \\ e_t^{M1} \\ e_t^{INT} \\ e_t^{CR} \\ e_t^{RER} \end{pmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & 0 & 0 & 0 & 0 \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 & 0 & 0 & 0 \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & 1 & 0 & 0 \\ \beta_{81} & \beta_{82} & \beta_{83} & \beta_{84} & \beta_{85} & \beta_{86} & \beta_{87} & 1 & 0 \\ \beta_{91} & \beta_{92} & \beta_{93} & \beta_{94} & \beta_{95} & \beta_{96} & \beta_{97} & \beta_{98} & 1 \end{bmatrix} \begin{pmatrix} \varepsilon_t^{OP} \\ \varepsilon_t^{FFR} \\ \varepsilon_t^{FER} \\ \varepsilon_t^{Y} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{M1} \\ \varepsilon_t^{INT} \\ \varepsilon_t^{CR} \\ \varepsilon_t^{RER} \end{pmatrix}$$

where $\varepsilon_t^{OP}, \varepsilon_t^{FFR}, \varepsilon_t^{FER}, \varepsilon_t^{Y}, \varepsilon_t^{INF}, \varepsilon_t^{M1}, \varepsilon_t^{INT}, \varepsilon_t^{CR}, \varepsilon_t^{RER}$ are structural disturbances.

3.2. Ordering of variables and identification structure

Following Zha (1999), Kim and Roubini (2000), and Dungey and Pagan (2000), the system is identified as a block recursive between the foreign and domestic variables. Since Sri Lanka is a small open economy, it is affected by external variables, but it is not affected by domestic variables. This is done by restricting the contemporaneous and lagged impact of domestic variables on all equations describing the evolution of the foreign block to be equal to zero. The oil price is ordered first, assuming it is contemporaneously exogenous to all other variables in the model. The oil price responds to the federal fund rate with a lag. The US federal funds rate is assumed to be contemporaneously affected by the oil price.

non-US G7 countries, Brischetto and Voss (1999), Suzuki (2004b), Dungey and Pagan (2009) for Australia, Raghavan et al. (2012) for Malaysia and Anwar and Nguyen (2018) for Vietnam.

[6] Real exchange rate is derived by multiplying the nominal exchange rate of the Sri Lankan rupees against the US dollars by the ratio of US consumer price index and domestic consumer price index, (P*/P)

[7] Fry and Pagan (2011) explain five different methods to recover structural parameters from the reduced form equation's estimated parameters. Four of these methods are related to parameter restrictions.

Q5 [MP = monetary policy]

It seems active FOREX management is part of MP in CBSL.

Why is "FER" ordered near the top of the "triangle"?

Should "FER" be sensitive to contemporaneous domestic indicators too?

How robust are results to this?

The foreign exchange reserve is ordered after the foreign block and assumed to be contemporaneously affected by external sector variables. The real out and inflation are placed fourth and fifth, respectively. We assume that they are contemporaneously exogenous to other domestic variables. The real GDP responds to the oil price, federal funds rate and foreign exchange reserves contemporaneously. Inflation reacts to the oil price, federal funds rate and foreign exchange reserves and domestic output contemporaneously. Assumption of a sluggish real sector is common in past studies. The money demand function is assumed to contemporaneously depend on external sector variables, foreign exchange reserves, real output, and inflation. The seventh equation represents the monetary policy reaction function. The Central Bank sets the interest rate after observing the current quarterly value of the external sector, foreign exchange reserve, real output, inflation and money demand. Bank credit and real exchange rate reacts contemporaneously to all the variables ordered above them. In this paper, we assume that the exchange rate responds contemporaneously to all other variables in the model.[8]

The model is estimated using quarterly data from 1996Q1 to 2019Q4. Table 2 in the Appendix provides a complete description of the data and its sources. The stationary test results suggest that apart from the domestic nominal short-term interest rate and the federal funds rate, all other variables are non-stationary at their levels (see Table 3 in the Appendix). Thus, we include stationary variables in the model after taking the first log differencing. The federal funds rate and interest rates, expressed in percentages, are used at their levels. In addition, the model includes a constant term and a time trend. The model also incorporates two lags and a dummy variable in the domestic block to represent the peace period after the civil war ended in Sri Lanka in mid-2009.

4. Empirical Results

4.1 *Monetary policy shock*

Fig. 1 reports the impulse responses of domestic variables to one-standard deviation monetary policy shock over 16 quarters along with two-standard-error bands.[9] The reported impulse responses are percentage deviations, except the interest rates, in basis points. The monetary policy shock and the effects of the monetary policy shock appear to be transitory. The interest rate returns to the baseline within four quarters after the initial shock. Then, it declines slightly below baseline for one more year before gradually returning to the original level. In response to a monetary policy shock, inflation gradually decreases and reaches its minimum (maximal response) in quarter three when the quarterly inflation rate is 0.2% lower than the baseline before returning to the initial level in two years.

Responses of output growth to monetary policy appear to be swift and unique. In response to a monetary policy shock, output decreases immediately and show a statistically significant "V" shape recovery. After an immediate recovery in quarter three, output growth continues to fall and return to the initial level in eight quarters. As predicted, demand for money decreases immediately after the contractionary monetary policy shock and gradually returns to the baseline after ten quarters.

[8] Similar restrictions are adopted by Brischetto and Voss (1999), Berkelmans (2005), Dungey et al. (2014) for Australia, Raghavan et al. (2012) for Malaysia and Anwar and Nguyen (2018) for Vietnam.

[9] All the eigenvalues (or roots of the equations) of base model lie within the unit circle, indicating that models are stable and yields valid impulse response analysis

Q6 Justification for assuming GDP and inflation are not contemporaneously correlated with other domestic variables?

Maybe credit outcomes → investment → goods Demand = Supply outcomes happen with a "time-to-build" lag?

Unclear assumption w/o any appeal to plausible theory / justification.

Q7. Notationally confusing.

It appears all variables apart from interest rates are I(1). In particular price level (CPI) is I(1). So authors use INF = ΔCPI instead. But labelling of other I(1) variable still use their "level" names. Inconsistent and unnecessarily misleading.

Q8 Reader / examiner not told what estimator is used.

* I'm guessing OLS. Need to be transparent on method.

* If you use standard software (eg. EVIEWS) say so. Be transparent: replicable science!

* Also, the IRF and VD "confidence intervals". Are those asymptotic / theoretical bands? (NOT explained.)

Would those be not very informative in short (sub) samples used?

* Also, we see that most of the IRFs are not stat. significant.

Have authors tried testing for cointegration and estimating a VECM using the level variables instead?

→ See Phillips '95, Chang-Phillips papers – VECM w/ mixture of I(n) variables.

Q9 What is MP shock?

- reader not told what was "identified" as the MP instrument or policy curve!
  - Is it INT?
  - Is it FER?

I think in CBSL's case it could be both!

How to separate demand effects vs. MP (supply side) shocks?

From Fig 1. Almost all financial + nominal response to INT "=" MP shock appear stat. insignificantly different from zero. But there is output contraction effect.

- Either try bootstrap IRF bands,

OR

- Consider FER as possible main CBSL policy instrument? (not studied at present)

In response to the monetary policy shock, credit declines sharply with the lag of one-quarter. The credit growth drops by 0.5% below the baseline after four quarters and gradually returns to the initial level after almost two years. Our result is consistent with the lagged response of credit to a monetary policy shock reported in past studies (Bernanke and Blinder (1992) for the US; Garretsen and Swank (1998) for the Netherlands; Tang (2006) for Malaysia). We can see that credit increases slightly above the original level before it returns to the steady-state level. The response of credit is somewhat more persistent than other variables.

Theory predicts that an increase in the interest rate causes the exchange rate to appreciate under a flexible exchange rate regime and free capital mobility. Following the Uncovered Interest Parity (UIP) condition and the predictions of Dornbusch (1976), an increase in the domestic interest rate relative to the foreign interest rate leads to an immediate appreciation of the exchange rate and a persistent depreciation over time (Kim & Roubini 2000). However, in developing countries that operate managed floating or pegged exchange rate regimes, the central bank's intervention in the foreign exchange market can hinder the effectiveness of the exchange rate channel. In our model, in response to a monetary policy shock, the real exchange rate appreciates only after an immediate depreciation. Maximum appreciation of about 0.4% occurs in the first four quarters after the shock. The duration and magnitude of overshooting are small compared to past studies; past studies have reported significant deviation and longer delay from the Uncovered Interest Parity (UIP) condition.[10] For Sri Lanka, Vinayagathasan (2013) and Perera (2016) document an exchange rate puzzle where the exchange rate depreciates persistently after a monetary policy shock. Our model's real exchange rate response shows that the exchange rate plays a nontrivial role in monetary policy transmission in Sri Lanka.

The initial depreciation of the real exchange rate decreases the foreign exchange reserves, indicating the central bank intervenes by selling US dollars in the forex market to stabilise the immediate exchange rate depreciation. Foreign exchange reserves, however, tend to increase as the exchange rate starts to appreciate.

In summary, the responses are broadly consistent with theory and past studies. Most of the reactions occur within six quarters after the shock, which is swifter than previous studies. However, Catão and Pagan (2010)[11] report a quicker response for Chile and Afrin (2017) finds a similar response for Bangladesh. Moreover, the credit and exchange rate channels play a nontrivial role in monetary policy transmission. The empirical findings show no puzzling results (i.e., price puzzle, exchange rate puzzle or liquidity puzzle); therefore, the estimated SVAR model has successfully identified monetary policy shock for Sri Lanka.

4.2 *Credit shock*

Fig. 2 displays the impulse responses of domestic variables to one-standard deviation credit shock. The model predicts transitory responses to a credit shock since they dissipate quickly. Catão and Pagan (2010) for Brazil and Chile and Afrin (2017) for Bangladesh have reported similar short-lived credit shocks. The credit shock itself returns to the baseline after six quarters of the initial shock. As anticipated, inflation increases immediately after the shock and remains volatile for six quarters before returning to the baseline. Following the volatile response around the steady-state

[10] As per the UIP and the predictions of Dornbusch (1976) , an increase in the domestic interest rate relative to the foreign interest rate leads to an immediate appreciation of the exchange rate and a persistent depreciation over time (Kim & Roubini 2000). However, in the literature, monetary policy effects on the exchange rate have been a contentious issue. Past studies have reported delayed overshooting and persistent appreciation (Bouakez & Normandin 2010; Eichenbaum & Evans 1995; Grilli & Roubini 1995; Heinlein & Krolzig 2012; Scholl & Uhlig 2008).

[11] Catao and Pagan (2010) found that output gap, inflation and real exchange rates return to steady state level in less than 5 quarters after a monetary policy shock.

Q 10

What is a "credit shock"?

Shock to supply of lending?

Or to demand?

Not identified. Whether D/S

shock, does that affect

how one should expect CBSL

to react?

ε^{CR} not very "structural"!

level, the real output returns to the baseline after six quarters. The central bank does not increase the interest rate immediately after the shock; instead, it sets the policy rate below the baseline. One plausible reason for such a response is that the Central Bank tends to keep the interest rate low since the credit boom is not promoting output growth. The minor and transitionary effect of credit shock on inflationary pressure permits the Central Bank to embark on an expansionary policy measure to stimulate output growth. Entrusted with the multiple objectives of maintaining price and economic stability, the Central Bank appears to respond to lower growth than the credit movement. The lower interest rate that prevails in the first four quarters causes the exchange rate to depreciate and foreign exchange reserves to decrease. In summary, the credit shock has a transitory effect on output growth and inflation.

4.3 *Oil price shock*

Fig.3 reports impulse responses to a positive oil price shock. Sri Lanka is a net oil importing country; hence, an oil price shock may negatively affect the output growth in Sri Lanka. However, in response to the oil price rise, Sri Lanka's real output growth increases immediately and fluctuates around the baseline until it returns to its original level. Senadheera Pathirannehelage (2016) also reports a positive output response to an oil price shock in Sri Lanka. Allegret et al. (2012) report similar results for several East Asian economies. Kilian (2009) argues that the oil price shocks could be triggered by both demand and supply shocks in the global crude oil market, and higher oil prices caused by the strong aggregate demand may not necessarily contract output. Accordingly, an oil price shock caused by an increase in global aggregate demand can be regarded as an aggregate demand shock originating from advanced economies. Emerging countries like Sri Lanka may benefit from the aggregate demand-driven oil price shocks. To check the robustness of this finding, we estimate the same model endogenising the US real output.[12] The impulse response of the US output also supports Kilian (2009) argument. The oil price shock can exert inflationary pressure on a net oil importing country by raising the production cost. As expected, domestic inflation increases following the oil price shock. The effects of oil price rise on domestic inflation seem to be more persistent.

The interest rate increases gradually to control the persistent inflationary pressure caused by the oil price shock. The interest rate rises 40 basis points above the baseline by the fifth quarter and returns to the original level after 12 quarters. The gradual rise in interest rate appears to discourage the demand for money. In response to the oil price shock, bank credit increases. The higher oil price causes production costs to increase and hence the need for bank credit. A rise in oil price may depreciate the exchange rate of a net-oil importing country by increasing the costs of imports. In our model, the real exchange rate does not depreciate instantaneously to an oil price shock; instead, it depreciates with a lag of two quarters and takes another four quarters to return to the original level. The impacts of oil price shock on the Sri Lankan economy is broadly consistent with theory and past studies. Including oil price in the model provides valuable information about the impacts of oil price rise and justifies the model identification we have used in this study.

[12] This paper does not report the results of this model.

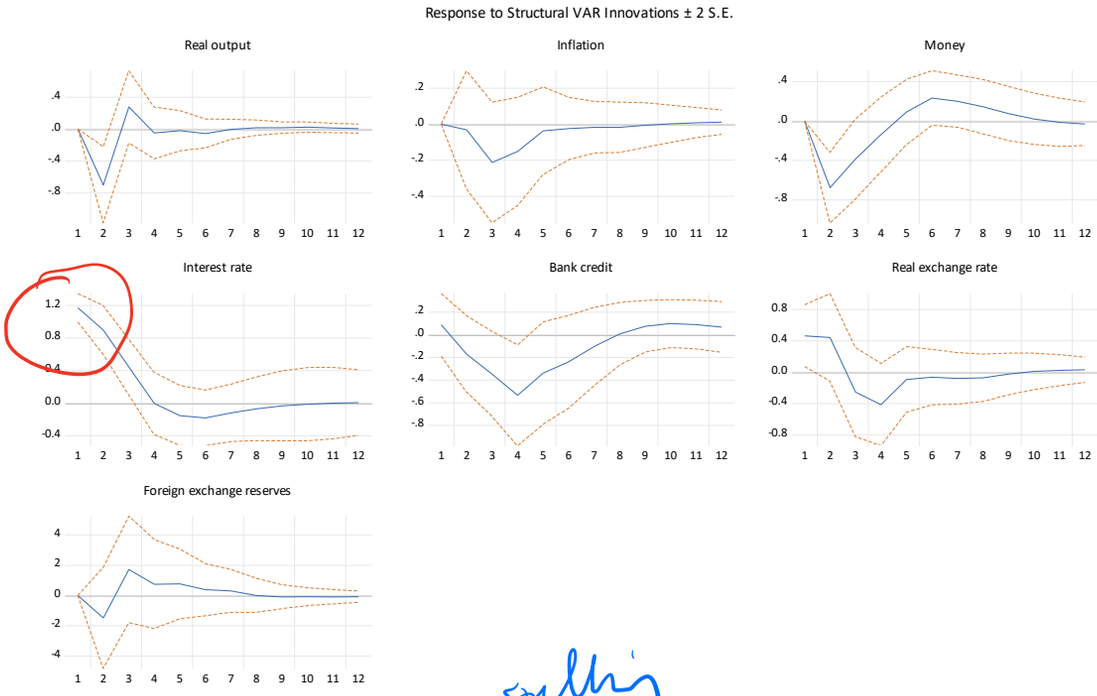


Fig 1: Impulse responses to a contractionary monetary policy shock

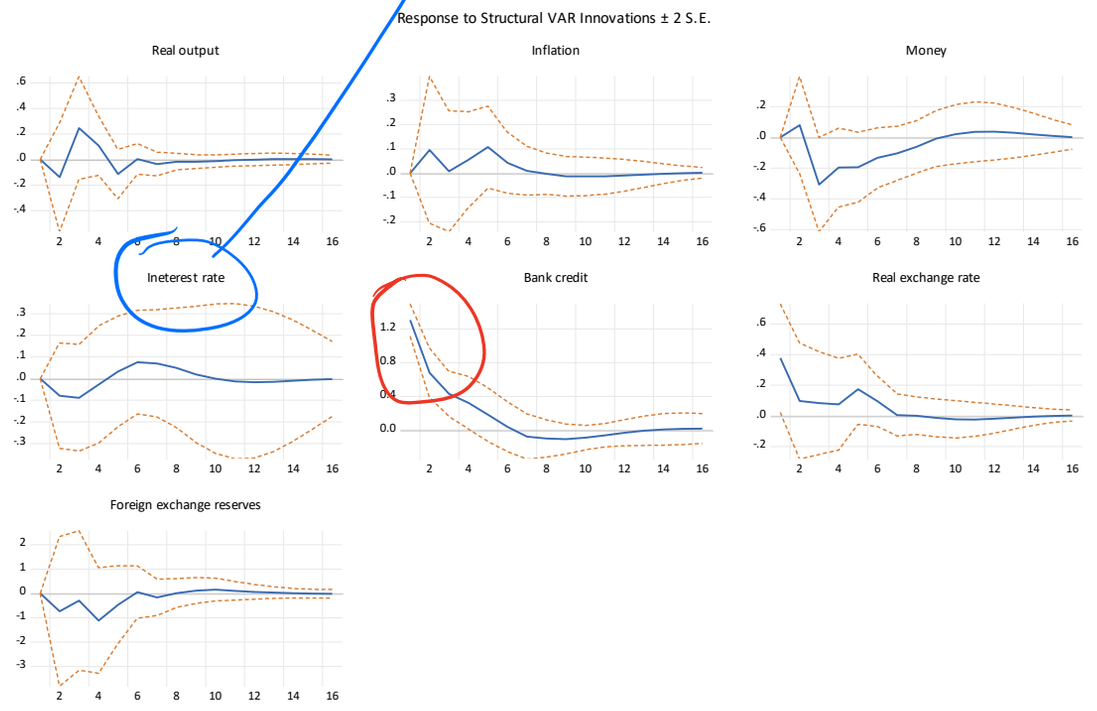


Fig 2: Impulse responses to credit shock

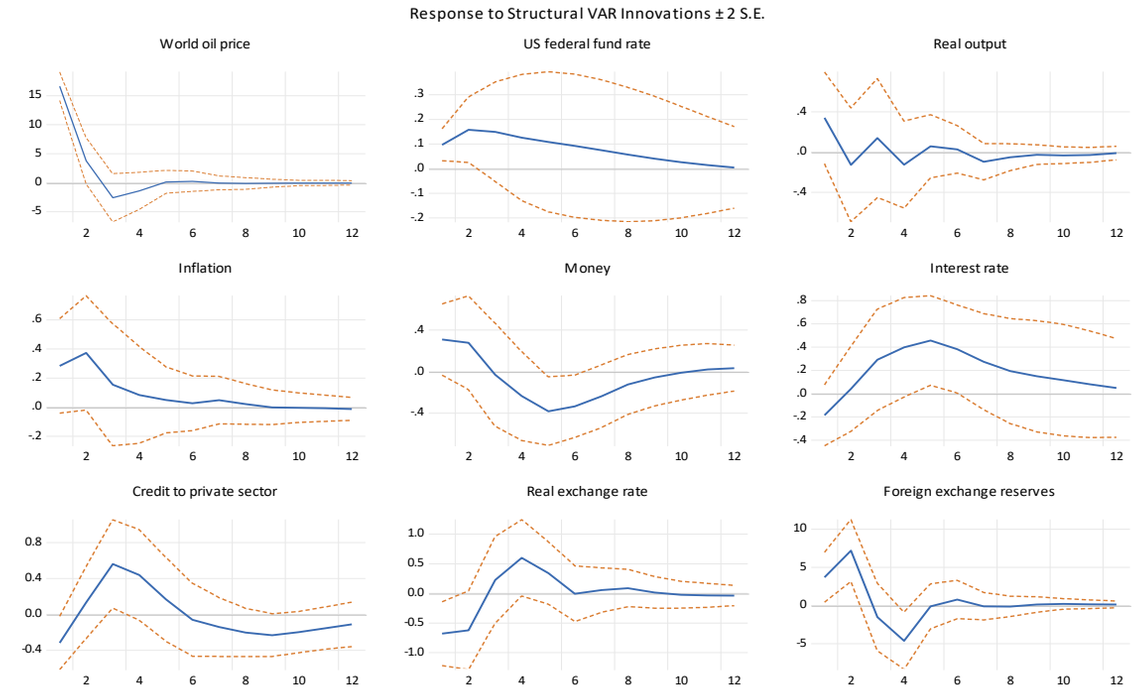


Fig 3: Impulse responses to oil price shock

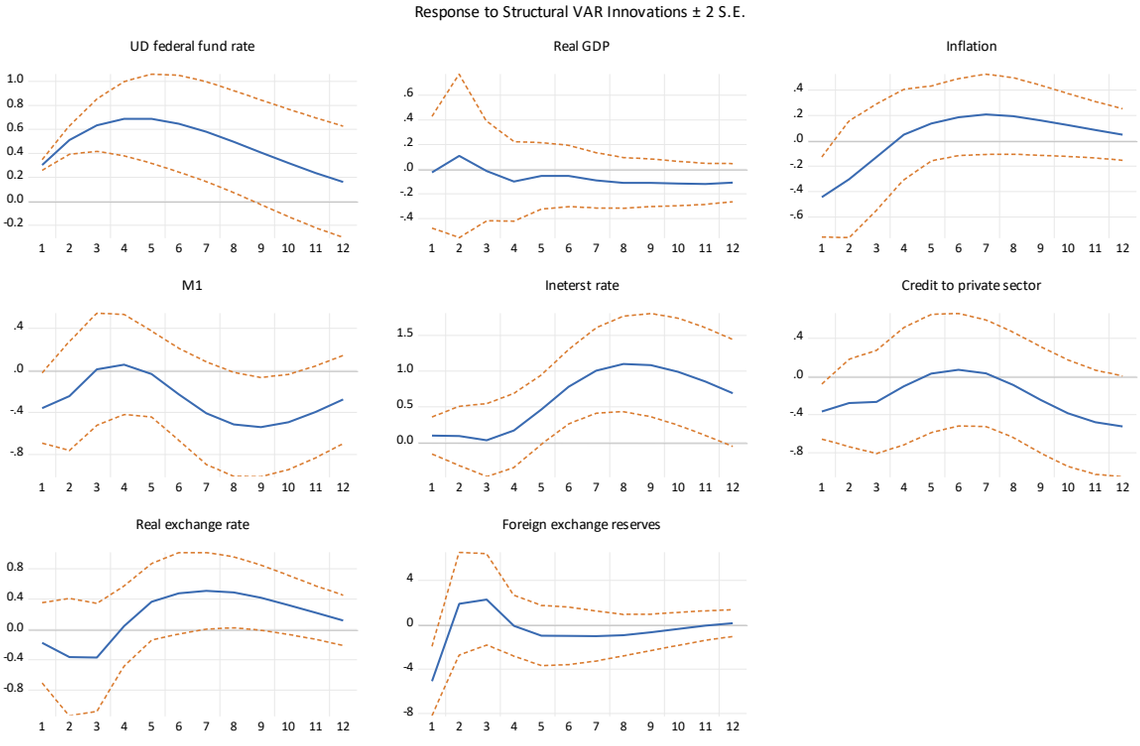


Fig 4: Impulse responses to the foreign monetary policy shock

4.4 *Foreign monetary policy shock*

Fig.4 presents the impulse responses of domestic variables to a rise in the US effective federal foreign rate. The foreign monetary policy shock appears persistent, taking more than three years to return to the baseline. Following the initial shock of 0.30 percentage points, the US federal fund

rate increases to 0.70 percentage points in quarter five. Then the US interest rate decreases back to the baseline. Theoretically, such an increase in the US interest rate tends to depreciate the exchange rate if a country follows a flexible exchange rate regime (Kim & Yang 2012). Sri Lanka's exchange rate appreciates in the short-run and then depreciates in the medium to long term. Kim and Yang (2012) also report similar exchange rate behaviour in East Asian economies. Sri Lanka's short-term interest rate responds strongly after three quarters due to the US monetary policy shock. Maćkowiak (2007) and Kim and Yang (2012) report an instantaneously strong reaction of domestic interest rate to US interest rate shocks in some East Asian economies such as the Philippines, Thailand, Taiwan, Singapore and Korea. In the medium to long term, Sri Lanka's interest rate tends to increase as much as the US interest increase, which helps to partly nullify the effects of US monetary policy shocks on the exchange rate.

The domestic inflation decreases immediately and then starts to increase from quarter three in response to US monetary policy contraction. The inflation responses are different from the findings of Maćkowiak (2007), who reports a more prominent and faster inflation response in the emerging market than the responses of the US inflation in response to a rise in the US interest rate. Sri Lanka's real output growth decreases with a delayed response to the US monetary policy shock, similar to Maćkowiak (2007) findings. However, the magnitude of output fall is smaller in our study. The responses of other variables are ambiguous. In summary, external shocks affect real output, inflation, short-term interest rate and exchange rate. However, these responses are by and large similar to other emerging countries. Monetary policy appears to be sensitive to external sector shocks as the Central Bank adjusts interest rates quickly and strongly in response to external shocks.

4.5 *Variance Decomposition*

Table 1 summarises the fraction of the variance of domestic variables explained by domestic and external shocks. Results are presented for 1, 4, 8, and 12 quarters ahead forecast horizon, and the discussion focuses on the point estimates.

The domestic monetary policy shocks are not a significant source of the fluctuations in domestic variables in the short term. However, in the longer horizon (12 quarters), domestic interest rate shock accounts for approximately 8.5% of the variation in domestic output growth, 11.2% of the variation in money demand, 8.5% of the variation in credit and 5.6% of the variation in the real exchange rate. Surprisingly, the domestic monetary policy shock accounts for approximately 2% of the variation in inflation throughout the forecast horizon. The lower explanatory power of monetary policy in domestic variables has been reported in previous studies (Lawson and Rees, 2008; Berkelmans 2005; Brischetto and Voss 1999; Dungey and Fry 2010; Anwar and Nguyen 2018).

The domestic output growth is mainly explained by its shock, which is consistent with previous findings. While most of the inflation variation is explained by its shock, external shocks account for a considerable percentage of that variation. The credit and real exchange rates do not appear to have significant explanatory power of the variations in the other domestic variables. The foreign exchange reserves contribute around 4% of the variation in real output and real exchange rate, 12% of the variation in money demand in the longer horizon and have no sizable impact on other variables.

Analysis of variance decomposition shows that external shocks are an important source of macroeconomic fluctuation in Sri Lanka. This conclusion is robust across different domestic variables except for real output. On average, external shock (i.e., oil price and the federal funds

Q11 Sri Lanka has had a lot of FDI net inflow.

I'm suprised this real-trade side of the economy is not measured and modelled.

Why / why not?

rate) explains 34% of foreign exchange reserves fluctuation, 22% of the variation in the inflation, 30% of the variation in the M1, 64% of domestic interest rate fluctuation, 24% of the variation in the private credit, and 24% of the variation in the real exchange rate, respectively in the longer horizon. Nonetheless, the external shocks explain only 4% of the variation in the domestic output movements.

4.6 *Monetary policy transmission during the conflict and post-conflict period*

To investigate how monetary policy transmission has evolved after the conflict in 2009, we estimate the baseline SVAR models for two sub-sample periods: the conflict period (1996Q1 to 2008Q4) and the post-conflict period (2010Q1 to 2019Q4). We examine the effects of the same size monetary policy shock in both periods. We choose one lag for both sub-sample models, considering fewer observations in each sample.[13] All other restrictions remain the same as in the benchmark model. Table 2 summarises the estimates of the impulse responses to a domestic monetary policy shock of 25 basis points (i.e., a contractionary monetary policy) over the two sub-sample periods. The reported impulse responses are expressed in percentage deviations, except for interest rates in basis points.

Several interesting findings emerge from this comparison. First, the patterns of the impulses in both periods are broadly similar to the total sample model except for the price puzzle that appears in the post-conflict period. Second, the effects of monetary policy shock are smaller and more short-lived in the conflict period than those associated with the post-conflict period. Most of the effects disappeared after eight quarters in the conflict period, while the effects lasted more than 12 quarters in the post-conflict period. For example, monetary policy shock dissipates after eight quarters in the conflict period while it takes more than 12 quarters in the post-conflict period. Third, credit is more responsive to monetary policy shock and plays a vital role in the shock transmission in the post-conflict period. Fourth, in response to a monetary policy shock, the exchange rate appreciates in both periods; however, in the post-conflict period, the exchange rate shows a "delayed overshooting" as it takes more than three years to return to the baseline level. However, in the conflict period, the appreciation lasts for four quarters. The significant difference in credit and exchange rate responses suggests their importance as transmission channels in recent years. Finally, the response of real output growth mimic the "V" shape pattern of the whole sample model in both periods; however, in the conflict period, output responses are transitory than those in the post-conflict period.

Table 1 Variance decomposition of domestic variables (%)

Variables	Horizon (quarters)	Innovations								
		OP	FFR	FER	Y	INF	M1	INT	CR	RER
FER	1	5.49	10.35	84.16	0.00	0.00	0.00	0.00	0.00	0.00
	4	23.40	9.05	57.42	1.32	2.76	2.48	1.50	0.51	1.56
	8	23.09	9.89	56.28	1.45	2.92	2.53	1.68	0.55	1.61
	12	23.06	10.04	56.15	1.45	2.91	2.53	1.69	0.56	1.61
Y	1	2.43	0.01	1.56	95.99	0.00	0.00	0.00	0.00	0.00
	4	2.54	0.34	4.14	76.76	0.22	3.90	8.62	1.49	2.00
	8	2.72	0.72	4.13	75.24	0.77	4.20	8.47	1.70	2.04
	12	2.73	1.49	4.11	74.59	0.76	4.18	8.42	1.69	2.03

[13] LR, FPE, AIC, and HQ recommend four lags and three lags for the models estimated for conflict period and post-conflict period, respectively, while SIC choose one lag for both. Both sub-sample models satisfy the stability condition only at one lag. The model estimated for post-conflict period does not satisfy the stability condition at two lags.

INF	1	3.30	8.01	0.90	0.69	87.11	0.00	0.00	0.00	0.00
	4	7.96	9.76	1.11	6.94	70.72	0.49	2.20	0.38	0.44
	8	7.68	13.24	1.29	6.57	67.01	0.77	2.15	0.81	0.48
	12	7.57	14.54	1.27	6.48	65.96	0.77	2.12	0.81	0.48
M1	1	3.50	4.75	11.16	0.00	0.00	80.58	0.00	0.00	0.00
	4	4.98	4.21	17.26	1.23	4.31	51.27	13.70	2.94	0.12
	8	9.39	11.43	14.26	2.91	4.32	41.20	12.68	3.58	0.22
	12	8.32	21.43	12.65	2.66	3.97	36.35	11.24	3.18	0.20
INT	1	2.22	0.62	4.68	0.00	1.67	3.34	87.48	0.00	0.00
	4	7.05	1.21	5.74	4.53	17.77	2.20	59.95	0.51	1.05
	8	9.58	39.76	3.12	2.91	10.73	1.28	31.45	0.45	0.72
	12	7.05	57.63	2.18	2.03	7.50	0.92	21.86	0.32	0.50
CR	1	4.90	6.59	0.11	2.13	1.34	1.11	0.39	83.43	0.00
	4	11.05	5.22	3.73	14.54	0.86	11.41	7.81	44.94	0.44
	8	10.85	4.69	6.27	12.92	1.59	14.47	9.40	39.29	0.51
	12	11.16	13.52	5.63	11.55	1.50	12.94	8.58	34.66	0.47
RER	1	6.77	0.46	0.12	5.44	33.77	0.38	3.16	1.23	48.67
	4	12.23	2.96	3.82	8.14	26.83	2.34	6.29	1.28	36.11
	8	11.95	9.94	3.82	7.32	23.90	3.04	5.79	2.10	32.12
	12	11.62	12.47	3.73	7.15	23.20	2.97	5.64	2.07	31.16

Note: OP = world oil price, FFR = federal fund rate, FER= foreign exchange reserves Y = domestic real output, INF = domestic inflation, M1 = narrow money, INT = short-term interest rate, CR = bank credit, and RER = real exchange rate

To allow comparisons across different periods, we obtain impulse responses for interest rate shocks of 25 basis points, rather than one standard deviation shock. However, the size of one standard deviation monetary policy shock is smaller in the post-conflict period (30 basis points) than in the conflict period (150 basis points), which suggests that the monetary policy shock impacts have diminished during the post-conflict period.

Qn

Table 2 The impulse responses to 25 basis points monetary policy shock

Time horizon (quarters)	FER		Y		INF		M1		INT		CR		RER	
	C	PC	C	PC	C	PC	C	PC	C	PC	C	PC	C	PC
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000
2	0.0615	-0.5560	-0.0527	-0.1770	-0.0552	0.1357	-0.0794	-0.3344	0.0984	0.2406	-0.0174	-0.1879	-0.0234	-0.0003
3	0.0335	0.2276	0.0097	0.0059	-0.0197	0.0461	-0.0304	-0.2665	0.0117	0.2001	-0.0151	-0.2571	-0.0341	-0.0187
4	-0.0166	0.1023	0.0107	-0.0247	-0.0026	0.0495	0.0020	-0.2010	-0.0134	0.1553	-0.0063	-0.2750	-0.0102	-0.0522
5	-0.0179	0.2052	0.0023	0.0026	0.0018	0.0247	0.0034	-0.1247	-0.0058	0.1107	0.0000	-0.2540	0.0024	-0.0743
6	-0.0022	0.1564	-0.0008	0.0026	0.0012	0.0147	0.0007	-0.0680	0.0002	0.0713	0.0009	-0.2128	0.0031	-0.0831
7	0.0016	0.1377	-0.0007	0.0082	0.0001	0.0042	-0.0003	-0.0247	0.0011	0.0393	0.0002	-0.1627	0.0005	-0.0781
8	0.0007	0.0991	-0.0001	0.0084	-0.0002	-0.0015	-0.0003	0.0035	0.0004	0.0156	-0.0001	-0.1135	-0.0003	-0.0662
9	0.0000	0.0683	0.0001	0.0084	-0.0001	-0.0051	-0.0001	0.0201	0.0000	-0.0005	-0.0001	-0.0706	-0.0002	-0.0511
10	-0.0001	0.0403	0.0000	0.0070	0.0000	-0.0065	0.0000	0.0275	-0.0001	-0.0100	0.0000	-0.0366	0.0000	-0.0360
11	0.0000	0.0193	0.0000	0.0055	0.0000	-0.0066	0.0000	0.0287	0.0000	-0.0145	0.0000	-0.0120	0.0000	-0.0227
12	0.0000	0.0043	0.0000	0.0039	0.0000	-0.0059	0.0000	0.0260	0.0000	-0.0154	0.0000	0.0042	0.0000	-0.0121

Note: FER= foreign exchange reserves Y = domestic real output, INF = domestic inflation, M1 = narrow money, INT = short-term interest rate, CR = bank credit, RER = real exchange rate, C=conflict period, and PC=post-conflict period

Q12

- Tell reader in the main text what "PC" and "C" stand are.

- Table 2 not very readable. Why not plot the graphs? Or the difference in the IRFs across "PC" vs. "C" regimes?

- What happened to the IRF error bands?

5. Sensitivity Analysis

We extend the baseline model in several ways to check the robustness of the results. First, we estimate the baseline model with different lags (i.e. three and four) while maintaining the same variables and restrictions. Fig. a and Fig. b in the Appendix report the impulse responses to a monetary policy shock[14] of models with three and four lags, respectively. The patterns of impulse responses are very similar to the baseline model, except for the reaction of inflation and credit in the model with four lags. Inflation in the four-lag model increases after a fall and remains above the baseline until seven quarters. The effect of interest rate shock on credit is not as persistent in the baseline model and the model with three lags. The results of the baseline model display little sensitivity to lag length.

Second, an alternative SVAR model with an extended external sector[15] is estimated to validate the robustness of the baseline SVAR model's key findings. The model includes the US real output[16] in addition to the variables included in the baseline model. Fig. c in the Appendix reports the impulse responses to a one standard deviation contractionary monetary policy shock. The results are identical to those of the baseline model.

Finally, we re-estimate the baseline model by replacing the real exchange rate with the nominal exchange rate to examine differences in their response. Fig. d in the Appendix reports the model results based on the nominal exchange rate. The impulse responses are almost identical to those of the baseline model. However, the nominal exchange rate responses are slightly weaker than those of the real exchange rate, suggesting that the nominal exchange rate and the ratio of the foreign price level to the domestic price level tend to move in opposite directions.

We also checked the model's robustness along other dimensions, though these are not reported here for brevity. For example, the effects of a monetary policy shock tend to be more persistent in models estimated using level and detrended data.

6. Conclusion

This paper empirically investigates Sri Lanka's monetary policy transmission using an SVAR model that reflects the features of small open economies. This study mainly focuses on the effects of monetary policy shock on the real economy, the role of credit and exchange rate channels in the monetary policy transmission, and finally, monetary policy transmission in the post-conflict period.

The empirical results suggest that the effects of a monetary policy shock are broadly consistent with theory and past emerging country studies. The impact of monetary policy shock on output and inflation are short-lived; most of the effects dissipate within six quarters. The empirical findings also reveal that the credit and exchange rate channels play a nontrivial role in monetary policy transmission as credit and exchange rate responses are more persistent than other variables.

[14] Impulse responses are estimated for one standard deviation monetary policy shock. The structural shocks of the baseline model (lag 2) and models with 3 and 4 lags are equal to 115, 120, and 118 basis points.
[15] The appended model includes the US real output in addition to other variables included in the base model. The US output is placed after the oil price and other variables and restrictions are remain same.
[16] We include the US GDP because of the strong relationship between Sri Lanka's business cycle and the US GDP. In the case of Sri Lanka, the US plays a dominant role as it has been the single largest export destination.

Furthermore, the credit shock has a transitory effect on inflation and output growth; hence, the Central Bank seems to be non-responsive to the credit boom. The fluctuation in the world oil price and US interest rate significantly impacts Sri Lanka's output growth, inflation, exchange rate, and monetary policy. The effects of external shocks are more persistent than those associated with domestic monetary policy and credit shocks. Sri Lanka's monetary policy is sensitive to external sector shocks, evidenced by the Central Bank strong responses to external shocks. These results suggest that Sri Lanka is vulnerable to external shocks, consistent with the small open economy studies.

The monetary policy shock has more significant and persistent impacts on domestic variables in the post-conflict period than in the conflict period. The improved credit and exchange rate channels play a vital role in the monetary policy transmission in the post-conflict period. Overall, the post-conflict financial sector development and the enhanced monetary policy conduct may have enhanced the monetary policy transmission.

Sri Lanka is transitioning towards a flexible inflation targeting framework; thus, the Central Bank should pay more attention to the nontrivial credit and exchange rate channels. Limited Central Bank intervention in the exchange rate market can enhance the effectiveness of the exchange rate channel. Furthermore, Sri Lanka is susceptible to external shocks; hence, a more independent monetary policy and a liberalised exchange rate regime may help withstand external shocks.

The findings of this study suggest that there is a change in the responses of macroeconomic variables to monetary policy shock after the end of the internal arm-conflict. This study uses an arbitrary structural break point to examine the difference in the responses of monetary policy shock between conflict and post-conflict period. Therefore, future research based on time-varying parameter models may reveal more evidence on the time-dependent responses.

Appendix

Table 1: Key banking sector statistics

	2000	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total Assets (Rs. Million)	944,451	3,550,515	4,252,234	5,098,219	5,941,473	6,971,832	8,077,474	9,046,583	10,292,397	11,793,992	12,522,707
Total Assets Growth	19.2	16.4	18.0	18.1	15.3	16.0	14.7	11.3	12.9	13.6	6.0
NPLs Ratio	13.6	5.4	3.8	3.7	5.6	4.2	3.2	2.6	2.5	3.4	4.7
Credit to Total Deposits	85.9	76.4	84.7	86.9	82.2	83.1	87.3	88	86.9	90.6	88.7
Deposits (Rs. Million)	609,516	2,586,032	3,072,544	3,625,374	4,169,520	4,686,306	5,403,131	6,295,559	7,399,006	8,492,427	9,162,264
Private Sector Credit (% of GDP)	24.5	23.25	27.79	27.01	26.42	26.57	31.43	34.89	36.01	38.71	38.61
Domestic Credit (% of GDP)	36.94	35.28	42.08	42.33	43.79	44.78	52.34	55.62	56.31	61.49	62.49
M2 (% of GDP)	27.2	28.3	30.4	29.7	31.9	33.4	37.1	40.2	42.5	44.7	46.0
Reserve Money Growth Rate	5.6	19.3	19.7	13.3	4.6	8.1	17.1	22.0	13.9	9.5	-6.6

Source: Author's calculation using the data published by the Central Bank of Sri Lanka

Table 2: Data descriptions and sources

Variables and Abbreviations	Variable	Source
World oil price (OP)	Global price of Dubai Crude Oil	Federal Reserve Bank of St. Louis
Foreign output (YUS)	Seasonally adjust annualised chain-linked quarterly real GDP series (2012=100)	Federal Reserve Bank of St. Louis
Foreign monetary policy (FFR)	US Effective Federal Funds Rate	Federal Reserve Bank of St. Louis
Real gross domestic product (Y)	A chain-linked quarterly series (2010=100) is derived using quarterly real GDP series of (1996=100, 2000=100, 2006=100 and 2010=100)	Central Bank of Sri Lanka (CBSL) and Department of Census and Statistics –Sri Lanka (DCS)
Domestic inflation (INF)	Quarterly change in the Colombo Consumer Price Index	IMF-IFS
Money demand (M1)	Quarterly average of the monthly series of narrow money supply	CBSL
Short-term interest rate (INT)	Money market rate	CBSL
Bank credit (CR)	Quarterly average of monthly series of the total credit granted to the private sector by commercial banks	CBSL
Foreign exchange reserves (FER)	Foreign exchange reserve excluding the gold	IMF-IFS
Real exchange rate (ER)	The LKR/USD nominal exchange rate is multiplied by the ratio of US consumer price index and domestic consumer price index (P*/P)	CBSL and IMF-IFS

Table 3: Unit root tests[17]

Variable	ADF		PP		KPSS		Decision
	Level	First Difference	Level	First Difference	Level	First Difference	
OP	-2.02	-8.47***	-1.72	-8.19***	0.21**	0.09	**I(1)**
FFR	-4.04***	-5.44***	-2.97	-5.60***	0.07	0.04	**I(0)**
FER	-2.92	-8.09***	-2.91	-9.39***	0.12	0.11	**I(1)**
Y	-1.29	-13.46***	-3.14	-13.77***	0.16**	0.50***	**I(1)**
CPI	-0.71	-7.94***	-0.49	-7.72***	0.22***	0.08	**I(1)**
M1	-2.90	-4.68**	-2.75	-7.78***	0.15**	0.04	**I(1)**
INT	-3.44*	-6.12***	-2.77	-5.96***	0.05	0.04	**I(0)**
CR	-2.85	-5.80***	-2.28	-6.05***	0.22***	0.04	**I(1)**
RER	-0.17	-6.12***	-0.19	-6.14***	0.16***	0.28***	**I(1)**

Note: OP = world oil price, FFR = Federal Fund rate, FER = foreign exchange reserves, Y = Domestic real output, CPI = Consumer price index, M1 = Narrow money supply, INT = Short-term interest rate, CR = Bank credit, and RER = Nominal exchange rate

(*), (**) and (***) indicates significant at the 10%, 5% and at the 1% respectively

[17] The null hypothesis of ADF and PP test states that the variable has a unit root (i.e., non-stationary) while the null hypothesis of the KPSS test states that the variable is stationary.

Fig a: Impulse responses to one-standard deviation monetary policy shock (3 lags model)

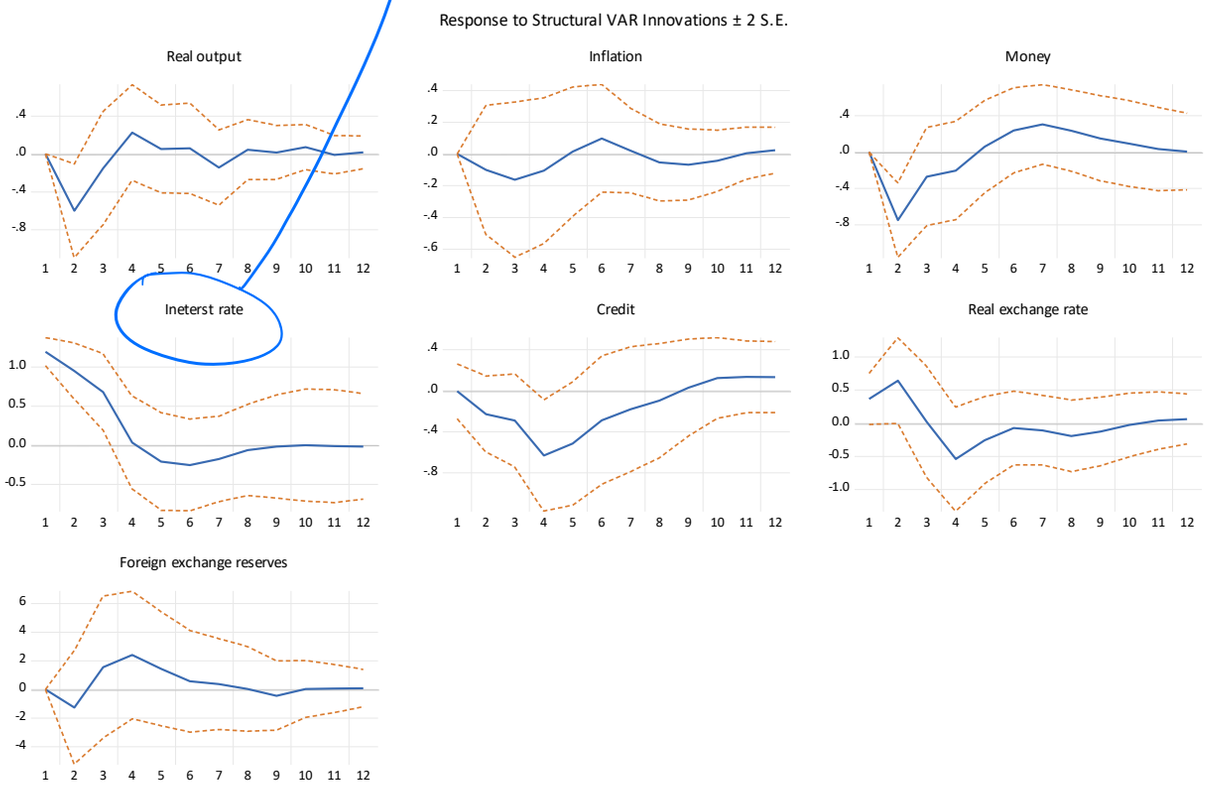


Fig b: Impulse responses to one-standard deviation monetary policy shock (4 lags model)

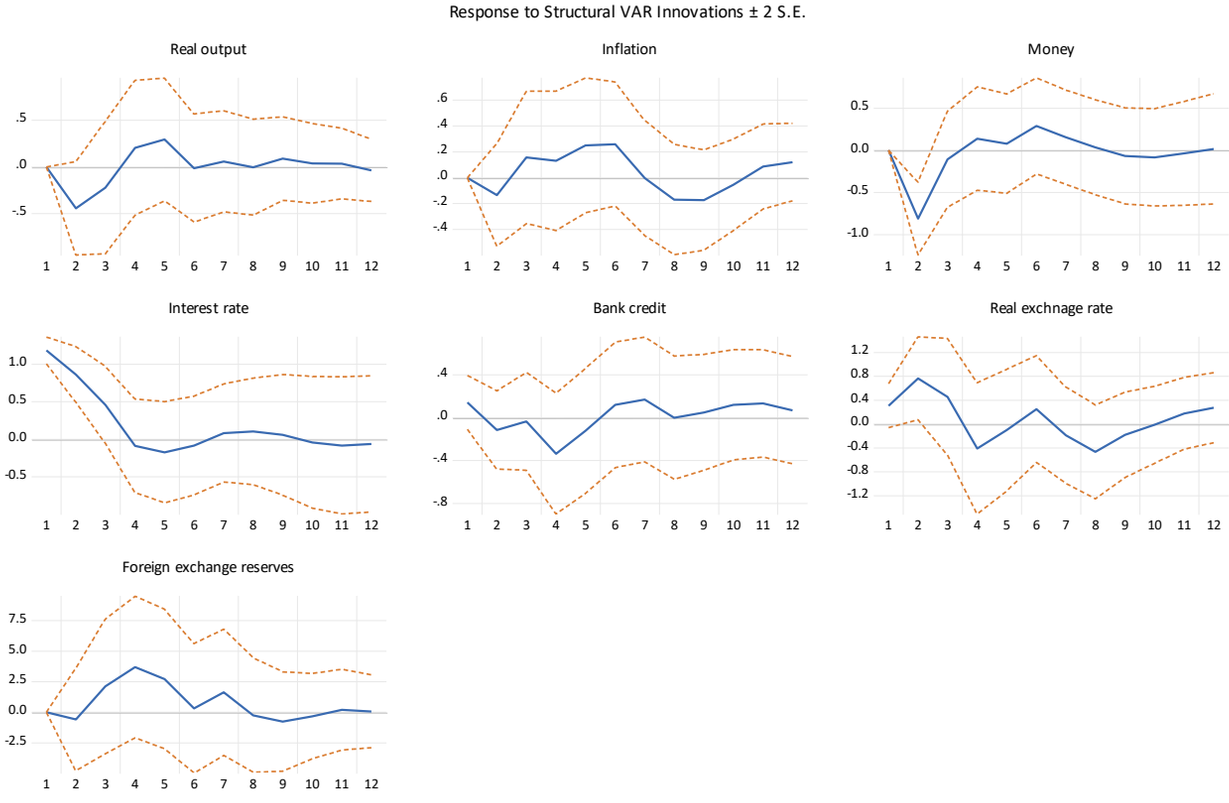


Fig c: Impulse responses to one-standard deviation monetary policy shock (model with an extended external sector)

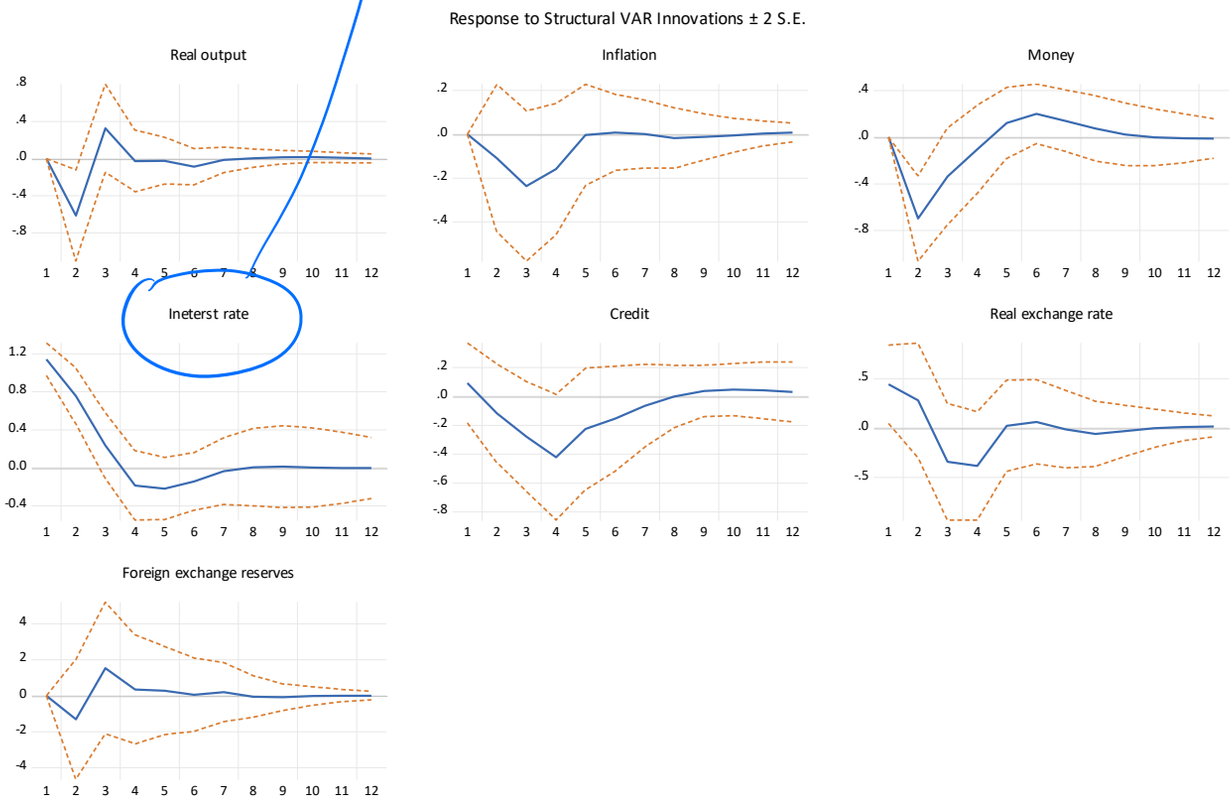
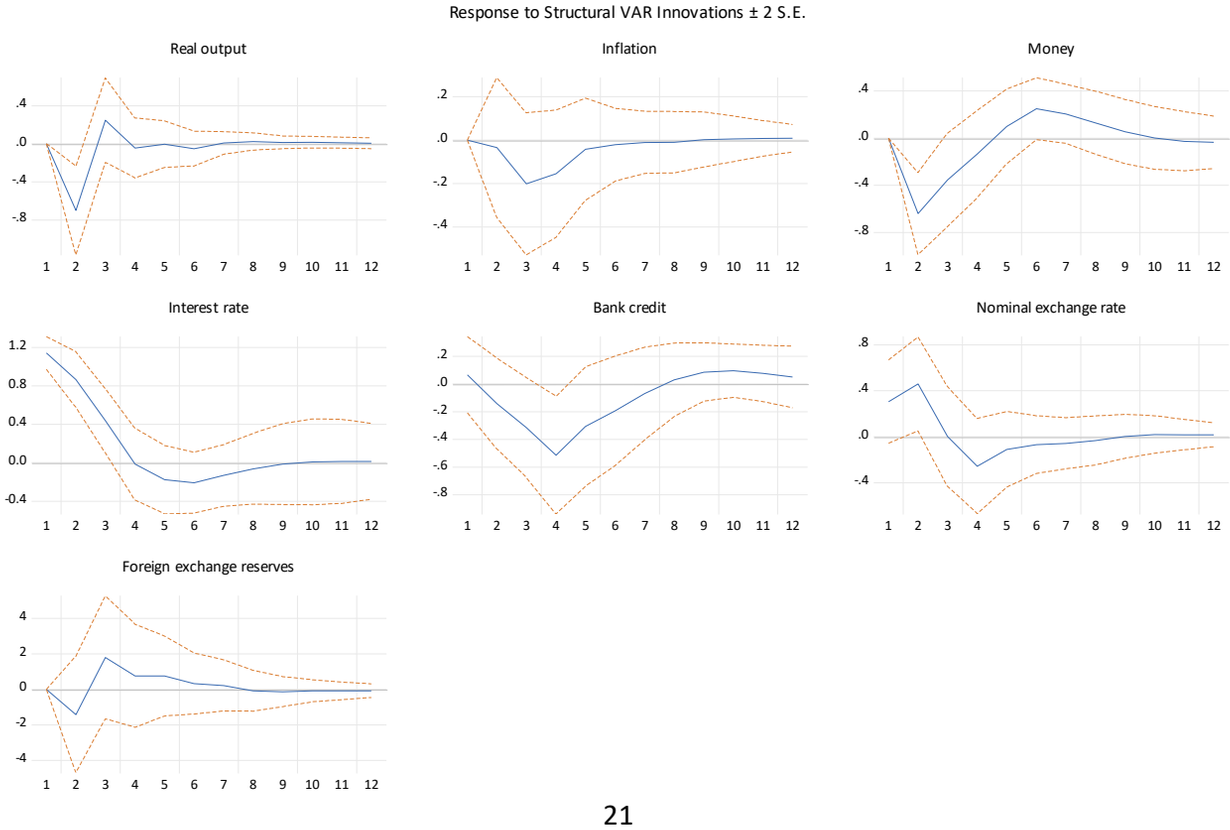


Fig d: Impulse responses to one-standard deviation monetary policy shock (model with nominal exchange rate)



Pls check consistency of citation style.

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inconsistency

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