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Liquidity Shocks and The Bank Lending Channel: Evidence from Lower-Middle Income Economies

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ABSTRACT- This paper examines the impacts of central banks' liquidity injections on commercial banks' credit supply in thirty-two lower-middle income economies over the period 1990 until 2020. We use a SVAR panel model to analyze the dynamic interactions between the central bank balance sheet policy, bank liquidity, and bank lending. The results show that liquidity injections have a non-significant impact on the credit to the private sector and a persistent positive impact on banks' liquid reserves. These results confirm the inefficiency of the bank lending channel in transmitting the central bank balance sheet monetary policy to the real economy in the considered LMIC's.

General Terms: E44, E52, E58, E59, G21.

Keywords: Bank-lending channel, monetary policy, unconventional measures.

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1. INTRODUCTION

Since the global financial crisis of 2008-2009 there was a widespread adoption of balance sheet policies by central banks in developed and developing economies. In the most general sense, balance sheet policies can be viewed as any balance sheet action taken by a central bank to influence asset market conditions beyond regulating the short-term interest rate (Borio and Disyatat, 2010). They include measures by which a central bank changes either the size or the composition of its balance sheet. Some of these policy measures were adopted even when the policy rate is not at its lower bound (Woodford, 2012). In this study, we consider the quantitative easing (QE)[1] through the changes in the size of the central bank balance sheet or central bank large assets purchase.

There are divergent theories on the channels through which balance sheet policies are transmitted to the real economy. In the developed economies, the literature identified two main *indirectly channels*: the portfolio balance channel and the signaling channel (Bernanke et al., 2004; Borio and Disyatat, (2010). The portfolio balance effect refers to the central bank's ability to influence liquidity premiums and term risk through open market operations (Bernanke et al., 2004). This effect was modeled by Vayanos and Vila (2009). Whereas, the signaling channel, refers to the central bank's ability to shape the expectations of market participants (Bernanke and Reinhart, 2004).

In addition, there are two main *direct transmission channels* through which the central bank large assets purchase could exert direct influence on banks' proclivity to lend. The first channel is the bank lending channel (Kashyap and Stein, 1994; and Kashyap and Stein, 2000). The second channel is the net-worth channel (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; and Bernanke et al., 1999). The advanced economies such as the United States, the European Union, and Japan used the QE as a last resort to stabilize the economy in a recession period (during which generally the official interest rate has reached the effective lower bound and can no longer be reduced). However, many emerging markets and lower-middle-income countries have embarked on quantitative easing programs with policy rates well above zero. In these economies, quantitative easing is often undertaken when the government is facing temporary but intense fiscal pressures.

Theoretically, the monetary policy transmission mechanism works differently in low-income countries because of their particular institutional characteristics, such as weak connections to international financial markets, illiquid and small securities markets, the widespread use of fixed exchange rate regimes. In the context of many low-income countries, the main channel of transmission must therefore be through bank lending. Montiel et al. (2010) and Montiel (2015) note that the typical description of monetary transmission used for high-income countries does not apply to many low-income countries, the lack of large, liquid, and well-functioning

[1]The term QE is widely used to describe the balance sheet policies conducted by central banks. The QE policy consists in increasing the size of the central bank's balance sheet by increasing the monetary base while keeping constant the liquidity and the average risk of its asset. It also consists in providing banks with more liquidity to boost lending and investment. This policy can constitute a substitute for the rate policy. Likewise, in certain cases, it can be implemented to improve the efficiency of the rate policy and considered complementary to rate policy.

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securities markets in these countries, their restricted integration with international financial markets, and their fixed exchange rate preference preclude the major roles of the interest rate, wealth, and exchange rate transmission channels. Hence, the bank lending channel is the principal channel through which the monetary policy actions can affect aggregate demand in most developing countries, by modifying the supply of intermediated credit, particularly the commercial bank loans[2].

The bank lending channel is a component of the credit channel, based on the idea that banks have a special role in the financial system, especially where asymmetric information problems can be pronounced such as for small firms. Indeed, large firms can access to finance directly through stock and bond markets rather than through banks. Therefore, an expansionary monetary policy that increases bank reserves and bank deposits is likely to impact the access to finance conditions of the borrowers. Schematically, the monetary policy effect is M↑→ bank deposits ↑→bank loans↑→ I ↑→Y↑. The bank lending channel (BLC) model of Bernanke and Blinder's (1988) suggests that open market sales by the central bank, which decrease reserves and thus deposits in the banking system, reduces the supply of bank loans by limiting banks' access to loanable funds. This effect is transmitted by the level and composition of bank assets, in addition to the traditional (IS-LM) effects of the money supply and interest rates, which are reflected in the decrease of bank liabilities. A key assumption of the model is that banks cannot substitute lost deposits with other sources of funds, for the BLC to exist, it must satisfy two conditions. The first condition is that contractionary monetary policy, leads to a decrease in bank deposits which is likely to reduce the loan supply. The second condition is that no other alternative source of corporate financing exists as a perfect substitute for bank lending.

The objective of our paper is to delve into the impacts of central bank assets purchase as a particular type of monetary policy[3], in the context of lower-middle-income countries (LMIC). The ultimate objective is to provide a better understanding of how this policy might affect banks' behavior in these economies. More specifically, we focus on the bank lending channel, which represents the main mechanism by which monetary policy is transmitted. Most of the studies investigated the transmission of QE policy in developed economies but few focused on developing economies. More specifically we try to respond to the following questions: *To what extent have the central bank assets purchase measures transmitted to non-financial corporations in LMIC?*

Most of the studies[4] on the effectiveness and transmission channel of the balance sheet policy, focuses on the experiences of developed countries where the interest rate is close to zero. Some other studies (e.g. Arslan and Hofmann, 2020; and Hofman and Kamber, 2020) examine the effectiveness of this policy in emerging markets during the crisis of covid-19. For a more general understanding of the effectiveness and transmission of the balance sheet policy in economies different from the developed economies, we track the central bank assets evolution (Changes in the size of central bank balance sheets) and the growth of bank lending in 32 LMIC over 30 years. The central bank asset program was adopted in many LMIC in different amounts, at different times, and during several financial pressures. Our analysis (part 3) reveals significant and visible increases in the size of central banks' balance sheets, during the considered period.

We analyze the dynamic interactions between the balance sheet monetary policy, bank lending, and the policy rate, using a structural panel VAR framework Peter Pedroni (2013), which takes into account responses to both common idiosyncratic and structural shocks, while allowing for full heterogeneity in response dynamics across members, this methodology makes it possible to isolate the causal relationship between the variables of interest without the need for internal instruments. Further, it allows for heterogeneous responses, and controls for cross-sectional dependence. This method adopts a fully structural approach, using impulse responses based on orthogonalized structural shocks with structural identification restrictions on the dynamics.

The remainder of the paper is structured as follows. *Section 2* provides a literature review on the effectiveness of central bank assets programs in developed and developing economies and the existence of the bank lending channel. *Section 3* describes the data and the empirical approach. Then, in *Section 4* we present the empirical results. Finally, *Section 5* concludes.

2. LITERATURE REVIEW

A large body of literature has shown that bank lending is associated with several macroeconomic, and bank-specific variables. Indeed, these variables have substantial influences on the lending behavior of banks. For example, Kashyap and Stein (2000) points out that small banks with less liquid balance sheets are more sensitive to monetary policy actions.

[2]In addition to the bank lending channel, the relationship between monetary policy interventions and the access to the credit could also take place through the balance sheet channel. Indeed, the monetary policy not only affects the balance sheets of borrowers. The existence of a differentiated credit channel within the monetary transmission mechanism was first highlighted in Bernanke and Blinder (1988) and Bernanke and Gertler (1995). They argue that credit channel should not only be viewed as an independent channel of monetary transmission but also as a kind of amplifier. This is largely due to the external finance premium in addition to the general level of interest rates. Monetary policy also affects the size of the external financing premium.

[3]The particularity of the QE and the specificity of its objectives and transmission channels can be different from the traditional channels (Wouter, 2016). The efficiency of QE relative to conventional monetary policies in stimulating the economy is questionable even in developed countries. Stiglitz (2016) criticizes the conventional and unconventional monetary policy practiced in developed countries. He argues that what matters is the availability of credit not the supply of money.

[4]See for example Lewis and Roth (2019), Greenwood, Hanson and Stein (2016), Woodford (2016), and Wu and Xia (2016).

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In the same frame, Peek and Rosengren (1995) and Stein (1995) conclude that the impact of monetary policy on the bank lending channel is stronger, in particular, for poorly capitalized banks. Kishan and Opiela (2000) uses US commercial banks data to show empirically, that the smallest and least capitalized banks are more sensitive to monetary policy. However, responses to the monetary policy actions are not significant for large banks. Matousek and Sarantis (2009) considers the impact of monetary policy on the loan supply in eight Central and Eastern European countries. The empirical results confirm the existence of a bank lending channel in all the countries, which depend on the bank characteristics such as the bank size and liquidity. Olivero et al. (2011) finds that more competition between banks leads to the less powerful transmission of the monetary policy through the lending channel. At the opposite, Huseynov et al. (2013) and Liebersohn (2017) find that competition has a positive impact on the efficiency and quality of bank lending and the effectiveness of the bank lending channel.

Mishra and Montiel (2014) using a structural heterogeneous panel VAR approach, finds that Monetary policy shocks are more likely to affect bank lending rates in countries with stronger institutional environments. The transmission of monetary policy shocks to bank lending rates is much lower in LMIC's than in advanced and emerging economies. Boughrara and Ghazouani (2010) uses a panel of bank balance sheet data to estimate the response of the bank lending channel to monetary policy shocks in four countries. Their empirical results confirm the presence of a bank lending channel in Jordan, Morocco, and Tunisia, while it is weak for the case of Egypt. Further, the bank size in both Jordan and Tunisia, bank capitalization in Jordan, and bank liquidity in Morocco appear to play a non-negligible role in the lending channel.

In the same vein, Al-Mashat and Billmeier (2008) finds that the GDP is more sensitive to the exchange rate fluctuations than to the interest rate. Similarly, Boughrara and Ghazouani (2011) shows that in Jordan lending by banks with a relatively weak capital base reacts more to a change in monetary policy stance than lending by better-capitalized banks. Likewise, the size of assets plays a significant role in shaping the response of Jordanian banks to monetary policy changes. The banks' size was also revealed to be a bank characteristic that significantly affects the way Tunisian banks react to monetary policy changes. For Morocco, only liquidity appears to play a role in this context. As for Egypt, the evidence for the existence of a bank lending channel is rather weak. Neaime (2011) evaluates empirically the transmission mechanism of monetary policy within the MENA region. He shows that the exchange rate played a dominant role in the transmission mechanism of the monetary policy in Egypt and Turkey. However, for Jordan, Lebanon, Morocco, and Tunisia, it is the interest rate that played a dominant role in the transmission mechanism of monetary policy.

Lojschova (2017) studies the impact of quantitative easing in Slovakia as conducted by the European Central Bank (ECB), using a data set from 2009 to 2016 consisting of 26 banks. They use short-term interest rates and deposit ratios as in Joyce and Spaltro (2014) to estimate short- and long-run relationships in their dynamic model. The results show that quantitative easing boosted household consumption and bank lending. Sims and Wu (2021) using a DSGE model to systematically study the main tools of unconventional monetary policy, they show that QE via an endogenous feedback rule can ease the constraints on conventional policy posed by the zero lower bound. Rodnyansky and Darmouni (2017) using a difference-in-differences regression to study the effect of FED's QE, finds a statistically significant positive effect on bank lending. Bowman et al. (2015) focus on the effects of Central Bank's asset purchase programs and bank lending in Japan, using data ranging from 2000 to 2009, applying a generalized method of moments (GMM), finds a positive relationship between the BOJ's asset purchases and bank lending. Mimir and Sunel (2021) investigates the efficacy of QE policies in EMEs, using a New Keynesian small open economy model with the financial sector shows that QE reduces long-term bond yields in these economies without creating bouts of currency depreciation.

Arslan et al. (2020) shows that the QE programs are taken by emerging markets. In response to the Covid-19 shock, were successful in restoring investor confidence and did not lead to a rise in inflation expectations, following the announcement of the QE programs, bond yields in local currency fell significantly, with little effect on exchange rates. Benigno et al. (2020) argues that quantitative easing would ease financial conditions, while minimizing the risks of significant depreciation and inflationary spirals in Emerging economies characterized by flexible exchange rate regimes and well-anchored inflation expectations. Hartley and Rebucci (2020) used a standard GVAR model estimated with quarterly pre-COVID-19 data to study the impact of quantitative easing (QE) announcements by 21 central banks on daily government bond yields and bilateral US dollar exchange rates amidst the global financial crisis triggered by the COVID-19 epidemic. They find that the impact of QE on emerging market bond yields is much stronger than in advanced and its transmission to exchange rates is qualitatively different from that of advanced economies.

3. DATA AND METHODOLOGY

3.1 The Sample

Our dataset is comprised of yearly macroeconomic and financial variables for thirty-tow, lower-middle-income economies (see Appendix 1) and covers the period from 1990 to 2020. We have chosen the variables of our model based on the common definition of the bank lending channel (in the sense of a monetary policy shock that increases bank deposits and reserves have a positive impact on the supply of bank loans (e.g.; Kashyap and Stein, 1995; Bernanke and Gertler, 1995; Mishkin, 1996)).

The balance sheet monetary policy measure is calculated by the ratio of central bank assets to GDP. This variable constitutes an absolute indicator of the central bank monetary policy stance. We also employed the ratio of domestic credit to

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the private sector (% of GDP) to control for the importance of the credit provided to the economy. The conventional monetary policy measure is defined as the real short-term central bank rate. Finally, we use the bank's liquid reserves to banks assets ratio to control the liquidity injected by the central bank and the lending channel. The data used in this paper are drawn from the World Bank database and the International Financial Statistics of the IMF.

Table 1. Variable Definitions and Sources

Variable	Definition	Sources
Credit: Domestic credit to private sector by banks	Financial resources provided to the private sector by other depository corporations (deposit taking corporations except central banks)	World Bank Global Financial Development database
Monpol~W:Real interest rate	The lending interest rate adjusted for inflation as measured by the GDP deflator.	International Monetary Fund (IMF)
QEW : Central bank assets	Claims on domestic real nonfinancial sector by the Central Bank as a share of GDP	World Bank Global Financial Development database.
Resevw: Bank liquid reserves to bank assets ratio (%)	Ratio of domestic currency holdings and deposits with the monetary authorities to claims on other governments, nonfinancial public enterprises, the private sector, and other banking institutions	WEO database; United Nations National Accounts.

3.2 Stylized Facts

Table 2 reports the descriptive statistics for variables. The mean value of Domestic credit to the private sector is 30.25%, which is between 361.7% and 1.38%, with a standard deviation of 29.29%. The average real interest rate is 5.92%, with a variability of 14%, and ranges between 52.1% and –97%. The Central bank assets to GDP ratio have a mean score of 6.76%, which has a minimum and maximum values of 90% and 0.004%, respectively, and variability of 9.83% as well. The average of the Bank liquid reserves to bank assets ratio is 27.92%, with variability of 37.47%, and ranges between 807% and 0% (See Appendix 2).

Table 2: Summary Statistics

Variable	Definition	Obs	Mean	Std. Dev	Max	. Min
Credit	Domestic credit to private sector by banks %	917	30.25	29.29	361.76	1.38
Monpol-w:	Real interest rate%	915	5.92	14.00	52.17	-97.69
QEW:	Central bank assets%	916	6.76	9.83	90.91	.0043
Reservew:	Bank liquid reserves to bank assets ratio (%)	940	27.92	37.47	0	807.79

The growth of the central banks' assets shows significant variability in the ratio of central bank assets to GDP (Appendix3), and especially large changes in the money supply between (2000-2003) after the Asian financial crisis, likewise in recent years after the crisis of (2008), and after the "Arabic spring" (2011). The statistic shows increases in the growth rate of the balance sheets assets of many central banks. In addition, the elasticity coefficient between the central bank assets and the credit is highly negative in some cases such as in Tunisia -1, 8 (2010-2011) and in Egypt -5, 2 (2013-2014). In these cases, the central bank assets and credit move in opposite directions. An increase of the injected liquidity by the central bank is correlated with an opposite change in credit which more than offsets the change in liquidity (superior to 1). In addition, the statistics show that the central bank assets and the liquidity reserves move in the same direction.

3.4 Methodology

In this section we assess the macroeconomic effects of balance sheet monetary policies by using a panel SVAR of Pedroni (2013), over the period 1990-2020 for the thirty-two lower-middle income countries. Pedroni's (2013) estimation and identification method is based on the assumption that structural shocks can be decomposed into common and idiosyncratic structural shocks, both of which are reciprocally orthogonal. Based on this framework, we derive a panel structural panel (PSVAR), the vector of endogenous variables $Y_{i,t}$ comprises four variables: banks liquid reserves, central bank assets, interest rate and banks credit, i = 1; 2……N, (N=32). In line with Pedroni (2013), we consider a panel composed of i = 1, ..., 32 individual countries, each of which consists of an K × 1 vector of observed endogenous variables (K=4), $y_{i,t}$, for $y_{k,it}$, k = 1, ..., K. the data are assumed to be observed over t = 1, ..., T_i time periods.

To accommodate fixed effects, we consider: K × 1 vector of demeaned data, z_{it}= ($z_{1,it}$ … … $z_{k,it}$)'.

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Where: $z_{it} = y_{it} - \bar{y}_i$

$\bar{y}_{k,it} = T_i^{-1} \sum_{t=1}^{T_i} y_{k,it}$ ∀i,k.

The composite white noise errors,

$$e_{it} = A_i \bar{e}_t + \check{e}_{it} \quad (1)$$

Where $\bar{e}_t' \text{ and } \check{e}'_{it}$ are K×1 vectors of common and idiosyncratic white noise shocks, respectively.

Let Ai K×K diagonal matrix such that the diagonal elements are the loading coefficients λ_{ik}, where k=1,…,K, $\mathcal{E}_{i,t}=(\bar{e}_t', \check{e}_{it}')$

$E[\mathcal{E}_{i,t}\mathcal{E}'_{i,t}]$= diag$\{\Omega_{i\bar{e}}, \Omega_{i\check{e}}\}$, ∀i,t.

$E[\mathcal{E}_{i,t}]$=0 ∀i,t, $E[\mathcal{E}_{i,t}\mathcal{E}'_{i,t}]$=0, ∀i, s ≠t and $E[\check{e}_{it}\check{e}'_{it}]$=0, ∀i ≠j,t.

The reduced form residuals $R_i(L)\Delta z_{it} = \mu_{i,t}$, $\mu_{i,t} = B_i(0)e_{it}$ (2)

$F_i(L) = R_i(L)^{-1}$ the response equal to $F_i(L)B_i(0) = B_i(L)$, e_{it} are the structural shocks δz_{it}=$B_i(L)e_{it}$.

To decompose the impulse responses into the common and idiosyncratic shocks use this re-scaled form:

$$B_i(L) = \bar{B}_i(L) + \check{B}_i(L)$$

Where $\bar{B}_i(L)$ is the member specific response to the common shocks, and $\check{B}_i(L)$ is the member specific response to the idiosyncratic shocks, the sum of the two responses gives the total specific response of the member to composite shocks. This PSVAR assumes both intertemporal dependence and cross-sectional of the data. Each shock e_{it} decomposed into a common component and an idiosyncratic component to model cross-sectional dependence. The common component captures the common shocks, across all countries. Rather, the independent cross-sectional disturbances is captured by idiosyncratic component $\check{e}_{it}$. The intertemporal dependence is modeled similar to conventional VAR models.

Following Pedroni (2013), the PSVAR model can be estimated through five steps:

1. Eliminate time-invariant fixed effects and then use the first-differenced to guarantee stationarity, the time effects $\bar{z}_{k,it} = N_t^{-1} \sum_{t=1}^{N_i} z_{it}$, we use Δz_{it} to estimate, the reduced form $R_i(L)\Delta z_{it} = \mu_{i,t} e_{it}$, for each country *i*.
2. Use adequate identification restrictions, Cholesky for short-run restriction or Blanchard and Quah for long-run restriction to obtain composite e_{it} and common $\bar{e}_t$ structural shock.
3. Compute the diagonal elements of Ai diagonal for each member, we used it to determine the compute idiosyncratic shock $\check{e}_{it}$, using *equation (1).*
4. Determine the member-specific impulse responses to unit shocks, $B_i(L) = \bar{B}_i(L) + \check{B}_i(L)$.
5. Describe properties of the confidence interval quantiles based on the estimated the member-specific impulse responses.

In the benchmark specification, the vector of endogenous variables $Y_{i,t}$ comprises four variables: banks liquid reserves, central bank assets, interest rate and banks credit, *i* = 1; 2……N=32. To verify that our variables have the appropriate time properties, we conduct the first and second generation panel unit root, Maddala and Wu (1999) test, Pesaran (2007) test. *Table 3* presents the results of the unit root tests of QEW, Credit, reservew and monopolicy for the variables in the system. At the 5% level of significance, the results find that time series variable, such as credit, QEW are having unit roots at the level data. This is because the null hypothesis of non-stationarity cannot be rejected by the estimated unit root test statistics at a 5% level of significance. However, they are stationary at the first difference level, as the null hypothesis of non-stationarity is rejected at a 5% level of significance (see *Table 4*). This confirms that these variables are integrated of order one, 1(1).

Table 3: First and Second Generation Panel Unir Root Tests

Variables :	Pesaran (CIPS)	MaddalaandWu (MU)	Pesaran (CIPS)	Maddala and Wu (MU)
	Without trend		With trend	
QEW	0.937	132.885	2.702	89.446
	(0.826)	(0.000)*	(0.997)	(0.000)*
reservw	-2.369	154.976	-1.283	121.095
	(0.009)*	(0.000)*	(0.100)	(0.000)*
credit	0.532	36.26	2.884	61.904
	(0.703)	(0.998)	(0.998)	(0.551)
monpolicyw	-9.482	376.976	-9.152	357.878
	(0.000)*	(0.000)*	(0.000)*	(0.000)*

Null for MW and CIPS tests: series is I(1). MW test assumes cross-section independence. CIPS test assumes cross-section dependence is in form of a single unobserved common factor. Multipurt stata command uses Scott Merryman's (xtfisher) and Piotr Lewandowski's (pescadf). Two lags are introduced to allow for serial correlation in the errors.

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Table 4: **First and Second Generation Unit Root Test (At Difference)**

Variables	Pesaran (CIPS)	MaddalaandWu (MU)	Pesaran (CIPS)	Maddala and Wu (MU)
Specification	Without trend		With trend	
QEW	-9.783	352.367	-8.100	265.332
	(0.000)*	(0.000)*	(0.000)*	(0.000)*
reservw	-15.460	521.402	-13.634	404.834
	(0.000)*	(0.000)*	(0.000)*	(0.000)*
credit	-11.692	489.805	-10.148	399.398
	(0.000)*	(0.000)*	(0.000)*	(0.000)*

MW (chi_sq) test assumes cross-section independence. CIPS (Zt-bar) test assumes cross-section dependence is in form of a single unobserved common factor. Two lags are introduced to allow for serial correlation in the errors.

Table 5: Cointegration Test

Alternative hypothesis: common AR coefs. (with in dimension)				
	Weighted			
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-1.567058	0.9414	-2.329182	0.9901
Panel rho-Statistic	3.581653	0.9998	2.955446	0.9984
Panel PP-Statistic	3.027586	0.9988	1.847076	0.9676
Panel ADF-Statistic	-0.175941	0.4302	-1.475979	0.0700
Alternative hypothesis: individual AR coefs. (Between dimension)				
	Statistic	Prob.		
Group rho-Statistic	5.028186	1.0000		
Group PP-Statistic	3.163464	0.9992		
Group ADF-Statistic	-0.399800	0.3447		

Null Hypothesis: No cointegration Trend assumption: No deterministic trend User specified lag length: 1 Newey-West automatic bandwidth selection and Bartlett kernel

Table 5 presents the results of the cointegration test, which analyses the long-term relationships between the panel series following the progress of the panel unit root tests. *Table 5* shows the results of the panel cointegration tests by Pedroni Panel Cointegration Test (1999, 2004) Engle -Granger Based Cointegration Test, (H 0: No Cointegration). As the robust p-value shows, the null hypothesis of no cointegration cannot be rejected by all tests. Therefore, the empirical properties of the variables examined require the estimation of the VAR in first differences, as there is no cointegrating relationship between the variables the adequate identification restrictions is short-run restriction.

- The first stage of the empirical analysis consisted in choosing the optimal order of lags in the panel VAR. Following Andrews and Lu (2001), the consistent moment and model selection criteria (MMSC) are the Bayesian information criterion (MBIC), the Akaike information criterion (MAIC) and the Hannan-Quinn information criterion (MQIC). The analysis shows that the preferred model in our situation is the first-order VAR panel as the first-order lag has the smallest MBIC and MQIC. (*Table 2* presents the model selection criteria).

Table 6: Model Selection Criteria

lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.9786087	59.49725	.1234658	-248.033	-36.50275	-118.8105
2	.984231	42.45372	.1024002	-162.5664	-21.54628	-76.41812
3	.6221733	22.01162	.1428166	-80.49846	-9.988376	-37.42429

We verify the stability properties of the panel VAR model for estimating the impulse response functions (IRFs) and the forecast error variance decompositions (FEVDs). The stability

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of the panel VAR model implies that the modulus of the dynamic matrix values lies within the unit circle. The results support the stability of the estimates (see *Appendix 4*). Finally, to test for robustness, we use different panel SVAR model specification.

4. RESULT AND DISCUSSION

This section discusses the impulse response functions of the panel SVAR. The areas between the upper and lower lines have a 95% confidence interval for the IRFs over the next 10 years. The impulse response functions represented by *graph 1* show the common, idiosyncratic and composite shocks. The three simulations show that a shock in the balance sheet monetary policy (QE) monetary has a non-significant impact on domestic credit to the private sector (% of GDP) for all the period (*column1 and row2, figures 1, 2, 3*). However, the QE monetary policy has a positive and persistent impact on the Bank liquid reserves to bank assets ratio (*column 1, row 3, figures1, 2, and 3).*

As mentioned earlier, the objective of our paper is to delve into the impacts of central bank assets purchase as a particular type of monetary policy, in the context of LMIC. Therefore, we focus on the bank lending channel, which represents the main mechanism by which monetary policy is transmitted. Where bank lending channel is a component of the credit channel, based on the idea that an expansionary monetary policy that increases bank reserves and bank deposits will have an impact through its effect on these borrowers. The bank lending channel (BLC) model of Bernanke and Blinder's (1988) suggests that open market purchases by the central bank, which increase reserves and thus deposits in the banking system, increase the supply of bank loans by stimulating banks' access to loanable funds. This effect is transmitted by the level and composition of bank assets, in addition to the traditional (IS-LM) effects of the money supply and interest rates. We have chosen the variables of our model based on the common definition of the bank lending channel. The balance sheet monetary policy measure is calculated by the ratio of central bank assets to GDP. This variable constitutes an absolute indicator of the central bank monetary policy stance. We also employed the ratio of domestic credit to the private sector (% of GDP) to control for the importance of the credit provided to the economy. The conventional monetary policy measure is defined as the real short-term central bank rate. Finally, we use the bank's liquid reserves to banks assets ratio to control the liquidity injected by the central bank and the lending channel.

The results show that liquidity injections have a non-significant impact on the credit to the private sector and a persistent positive impact on banks' liquid reserves. These results confirm the inefficiency of the bank lending channel in transmitting the central bank balance sheet monetary policy to the real economy in the considered sample of LMIC'.

The robustness check is examined via a different panel SVAR specification where in the first specification (*figure 4*) we integer the GDP growth as endogenous variable and in the second specification (*figure 5*) we eliminated the impact of conventional monetary policy (the interest rate variable). The impulse response functions (*Figure 3*) indicate that bank liquid reserves respond positively to QE monetary policy. However domestic credit to the private sector (% of GDP) doesn't have a significant response to QE monetary policy, and the results are similar to those of the first simulations.

5. RESULTS

This study employs the heterogeneous Panel Structural Vector autoregression (PSVAR) model of Pedroni (2013) to assess if central bank balance sheet policy affects credit and bank liquid reserves. The contribution of this study is to evaluate the extent to which monetary policy was transmitted by lending channel in thirty-two lower-middle income economies, over the period 1990 until 2020.

The impulse response functions show that a shock in QE monetary policy has a non-significant impact on domestic credit to the private sector and a positive impact on the Bank liquid reserves to bank assets ratio. These results confirm the inefficiency of the bank lending channel in transmitting the central bank balance sheet monetary policy to the real economy in LMIC. Similarly, Berger et al. (2018) reveal liquidity hoarding and bank credit retrenchment when policy uncertainty rises. Stiglitz (2016) argues that the supply of credit, provided by private banks, does not respond systematically or mechanically to the amount of money produced by the Central Bank. The money available cheaply can be used for harmful speculative activities, rather than productive investments. According to Stiglitz (2016), this problem has little to do with the Zero Lower Bound (ZLB). Hence, the effects of balance sheet policies LMIC would be limited if banks decided to hold more reserves either to deal with regulatory constraints or due to their reluctance to finance productive activities (Diamond and Rajan, 2011).

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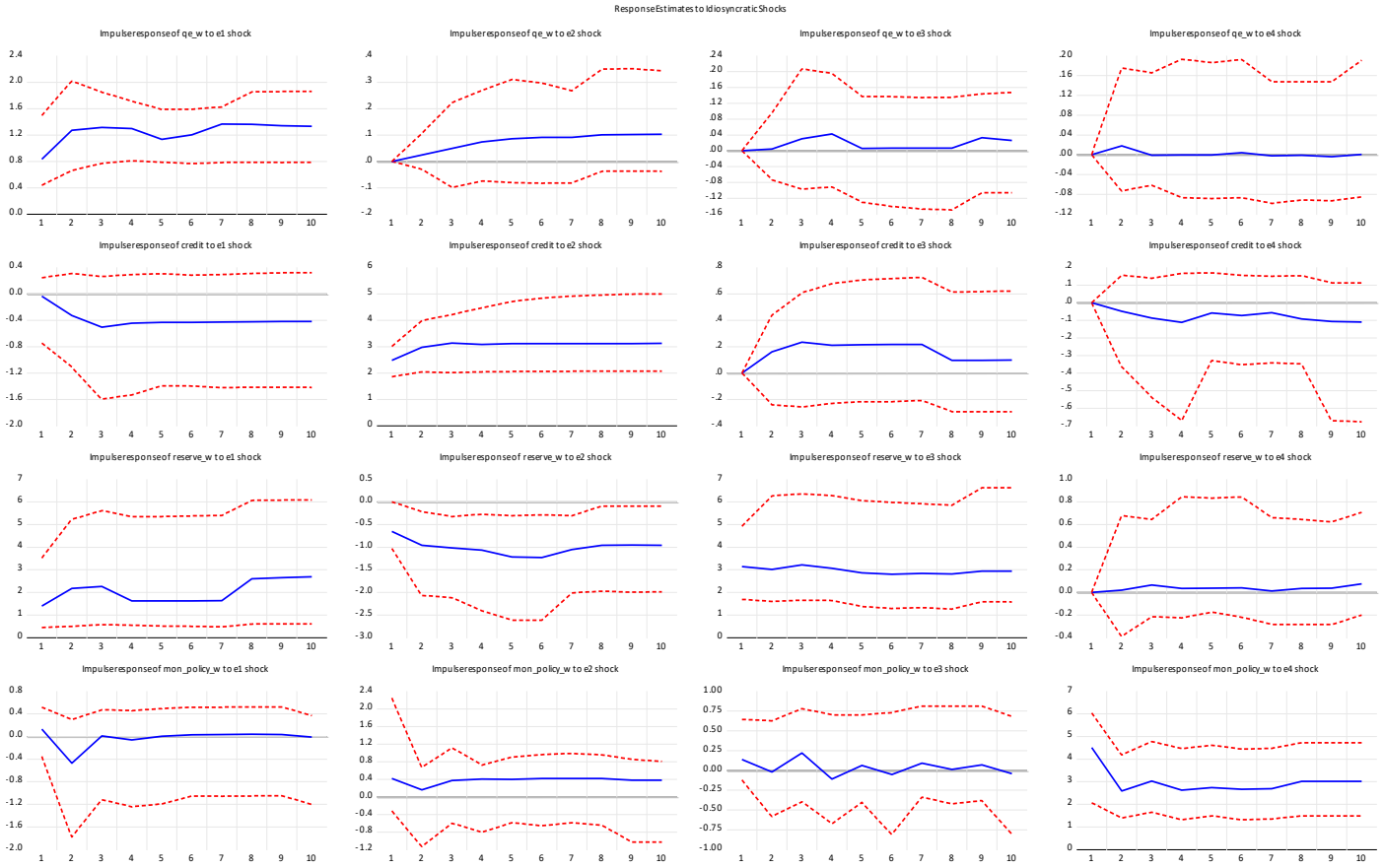

(Source: Estimation of Authors)

Figure 1: Response Estimates to Idiosyncratic Shocks

(Source: Estimation of Authors)

Figure 2: Response Estimates to Common Shocks

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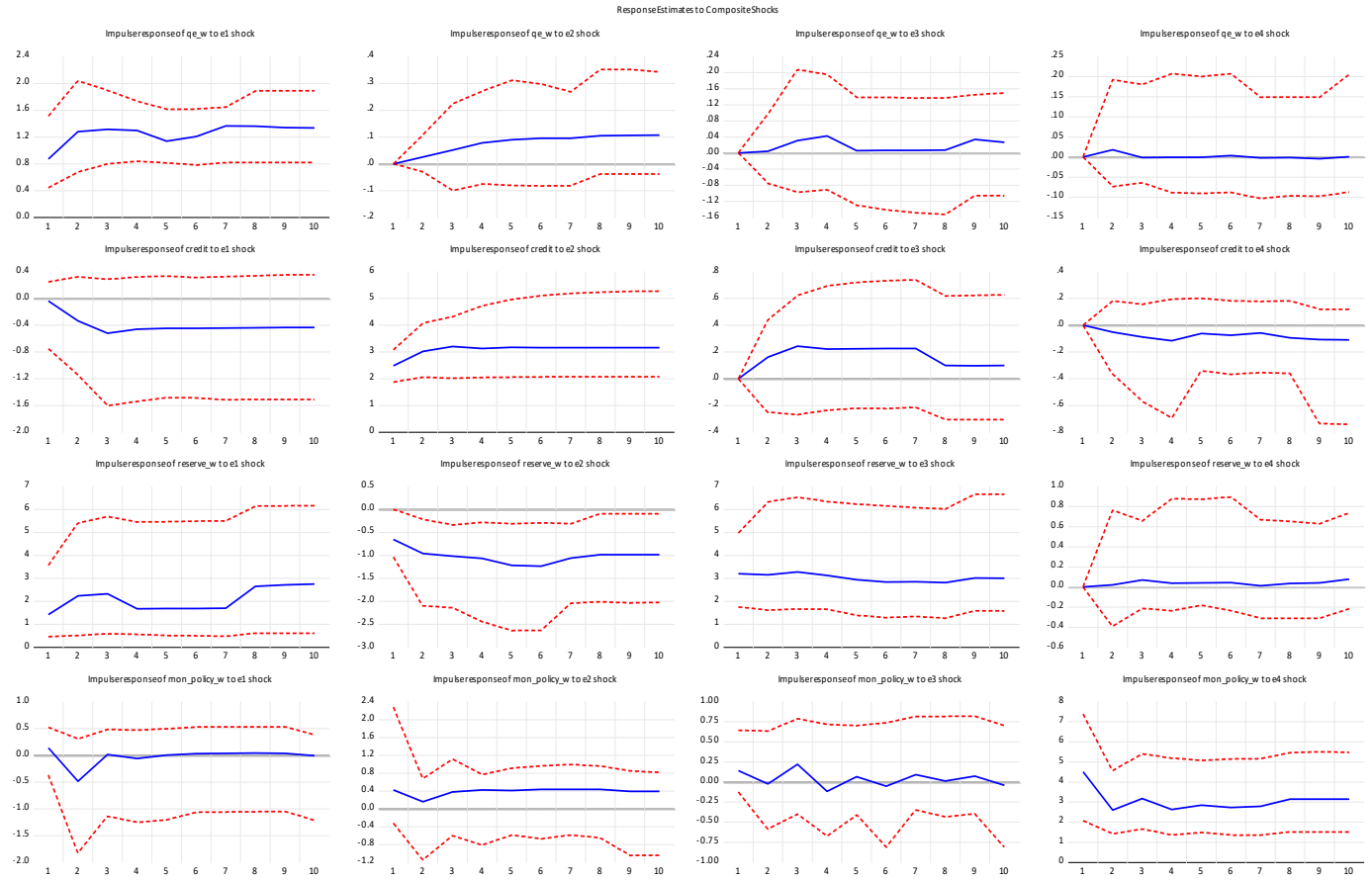
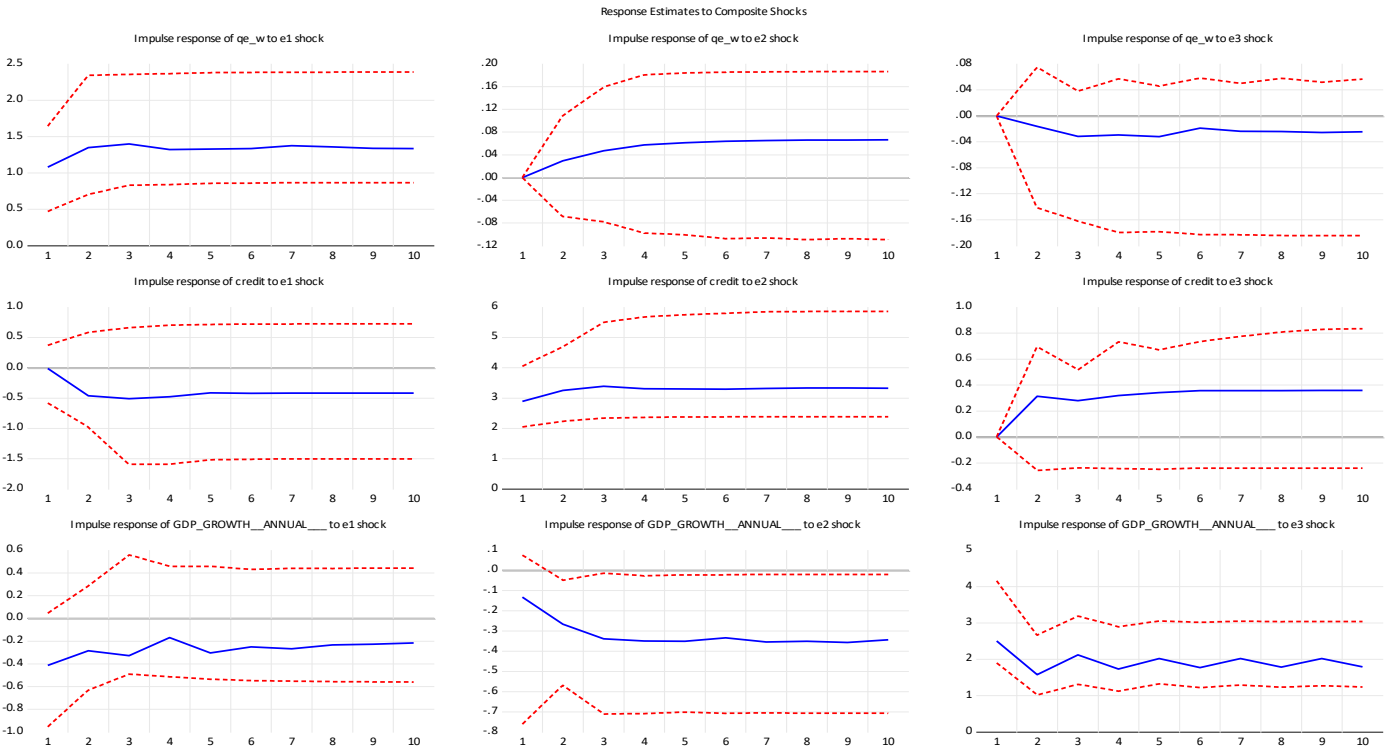


(***Source:*** *Estimation of Authors*)

Figure 3: Response Estimates to Composite Shocks



(***Source:*** *Estimation of Authors)*

Figure 4: Response Estimates to Composite Shocks

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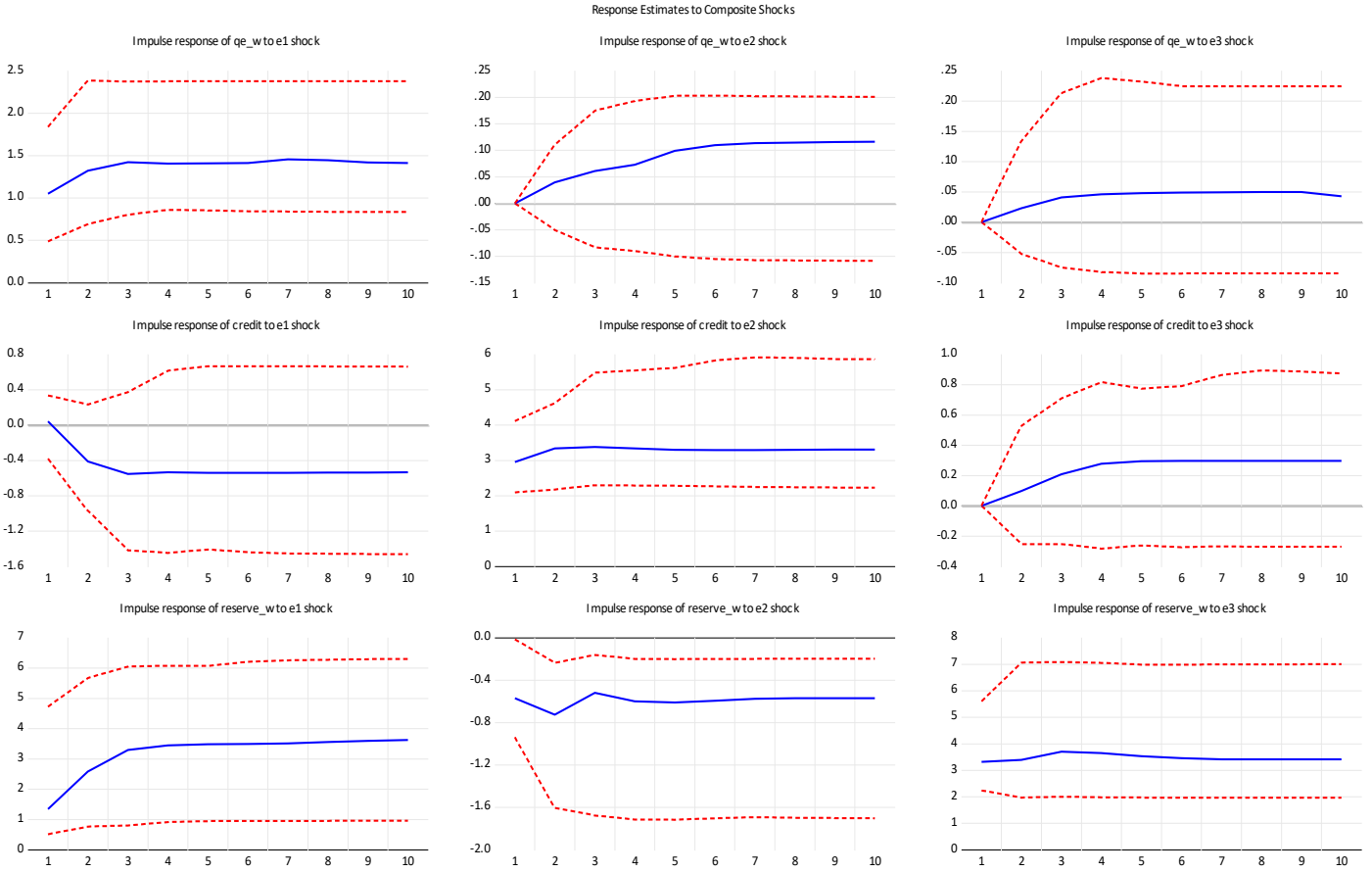

*(**Source:** Estimation of Authors)*

Figure 5: Response Estimates to Composite Shocks

APPENDIX

The guarantees of impartiality, which are a right established in administrative systems in general, must be observed, and we believe that the Saudi regulator should stipulate them in the employee discipline system.

- **Appendix (1):** Thirty-two lower-middle income emerging economies

Algeria	Angola	Bangladesh	Benin
Bhutan	Bolivia	Cabo Verde	Cambodia
Cameroon	Egypt, Arab Rep.	Eswatini	Honduras
Kenya	Kyrgyz Republic	Lesotho	Mauritania
Moldova	Mongolia	Morocco	Nicaragua
Pakistan	Papua New Guinea	Philippines	Senegal
Solomon Islands	Sri Lanka	Tanzania	Tunisia
Ukraine	Vanuatu	West Bank and Gaza	Zimbabwe

- **Appendix (2):** Summary Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
QEW_h	overall	6.765794	9.833193	.004378	90.913	N = 916
	between		7.785126	.1606882	38.30841	n = 32
	within		5.966566	-27.49224	59.37038	T-bar = 28.625
credit_h	overall	30.25698	29.2906	1.38539	361.763	N = 917
	between		24.4224	9.471811	143.6187	n = 32
	within		20.9189	-91.79749	248.4013	T = 28.6563
reserv~h	overall	27.92899	37.47144	0	807.7915	N = 940
	between		20.34679	5.284359	86.17285	n = 32
	within		31.79063	-38.52975	749.5476	T-bar = 29.375
monpol~h	overall	5.927765	14.00382	-97.6935	52.17075	N = 915
	between		6.938779	-15.1066	21.37127	n = 32
	within		12.13687	-88.45234	60.01031	T-bar = 28.5938

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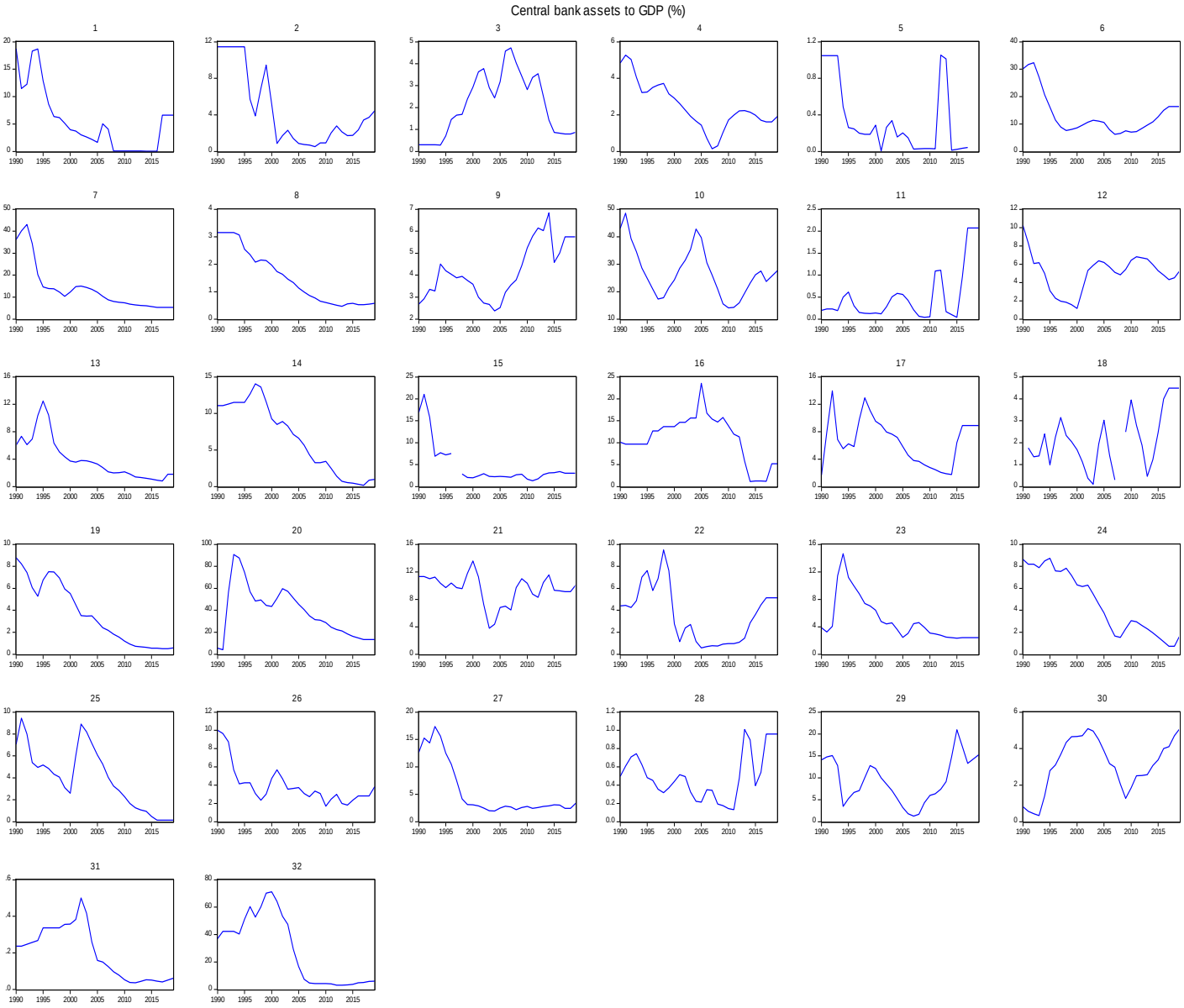
Appendix (3): Variability in the ratio of central bank assets to GDP



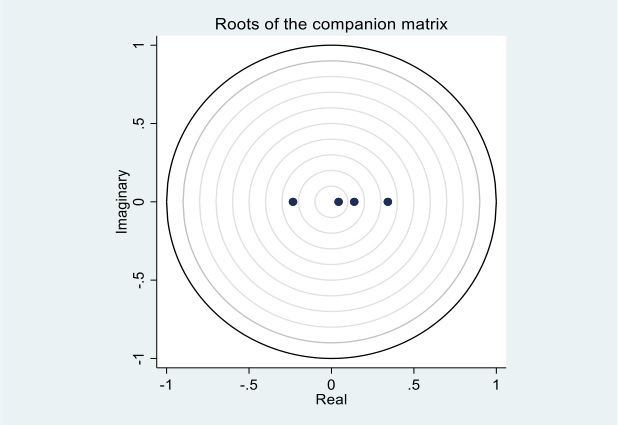
- **Appendix (4):** Stability Test

```
. pvarstable, graph

   Eigenvalue stability condition
```

Eigenvalue		
Real	Imaginary	Modulus
.3420588	0	.3420588
-.2333114	0	.2333114
.1381769	0	.1381769
.0433338	0	.0433338

```
   All the eigenvalues lie inside the unit circle.
   pVAR satisfies stability condition.
```



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- **Appendix (5):** FEVED

Response of dcredit to shock in dQEW

step	IRF	Lower	Upper	FEVD	Lower	Upper
0	-.9873592	-1.827496	-.3487576	0	0	0
1	-.181964	-.5906975	.2209741	.0116686	.0015201	.0399533
2	-.1981975	-.5912476	.2021841	.0119912	.0017637	.0404866
3	-.1876347	-.4639577	.1122652	.0123197	.0022741	.0403507
4	.0081735	-.1178494	.1158872	.0127206	.0028165	.0406957
5	.0965633	-.0223328	.2149336	.0127165	.0028286	.0406815
6	.0475728	-.0135656	.1202731	.0128237	.0028638	.0407522
7	-.0073466	-.0338605	.020234	.0128498	.0028798	.0407669
8	-.0195624	-.0447945	.0030742	.0128503	.0028799	.0407672

Response of dreservew to shock in dQEW

step	IRF	Lower	Upper	FEVD	Lower	Upper
0	3.002351	2.218629	3.748571	0	0	0
1	1.728642	1.300956	2.201231	.1138185	.0658008	.1598338
2	-.1876903	-.593048	.2207683	.1446269	.0908555	.1978306
3	-.76496	-1.069318	-.4634913	.1425037	.0907809	.194246
4	-.3640196	-.5186903	-.2387234	.1481813	.0970691	.1982612
5	.0453934	-.0423023	.1463837	.1494347	.0984884	.2000695
6	.1485497	.078266	.2387808	.149395	.0984547	.2000069
7	.0776272	.0414853	.1294056	.1496052	.0986857	.2002949
8	-.003074	-.0376543	.02542	.1496646	.0987762	.2003835

Response of dmonpolicyW to shock in dQEW

step	IRF	Lower	Upper	FEVD	Lower	Upper
0	1.072222	.3578896	1.624856	0	0	0
1	-.4776166	-.9547904	-.0511244	.0146591	.0015055	.0322185
2	-.3221742	-.742743	.1229429	.0156456	.0018028	.035097
3	.1315248	-.0915357	.3874561	.016256	.0027594	.0354827
4	.1048423	-.0503375	.2579326	.0161794	.0028012	.0354692
5	.0212056	-.0714239	.1147181	.0162859	.0031439	.0355056
6	-.010329	-.0467578	.0248123	.0162795	.0032157	.0355224
7	-.0214239	-.0512861	.0010559	.0162772	.0032329	.035522
8	-.0089842	-.0303912	.0046358	.0162818	.0032429	.0355373

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