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The Role of Different Channels in Transmitting Monetary Policy into Output and Price in Vietnam

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Abstract

The paper investigates the mechanism of monetary transmission in Vietnam through different channels - namely the interest rate channel, the exchange rate channel, the asset channel and the credit channel for the period January 1995 - October 2009. This study applies VAR analysis to evaluate the monetary transmission mechanisms to output and price level. To compare the relative importance of different channels for transmitting monetary policy, the paper estimates the impulse response functions and variance decompositions of variables. The empirical results show that the changes in money supply have a significant impact on output rather than price in the short run. The impacts of money supply on price and output are stronger through the exchange rate and credit channels, but however, are weaker through the interest rate channel. The impacts of monetary policy on output and inflation may be erroneous through the equity price channel because of the lack of an established and well-functioning stock market.

Keywords: Monetary transmission channel; output; price; VAR; Vietnam.

1. Introduction

Most economists would agree that monetary policy can significantly affect the course of the real economy, at least in the short run. Therefore, it is crucial to have a good understanding of the channels through which monetary policy is transmitted. According to many textbooks, an increase in the money supply should lead to a decrease in the short-term interest rate, which influences spending on investment and consumption. In turn, changes in aggregate demand affect the level of production and price. Monetary transmission is also implemented through other channels such as the exchange rate channel, the equity price channel, and the credit channel. However, the effectiveness of monetary transmission differs substantially across countries, especially in transition economies where the market economy mechanism is still rudimentary. However, there are very few studies investigating this mechanism quantitatively for Vietnam. Therefore, in this paper, we address several questions. First, does an increase in the money supply affect significantly output and price level in Vietnam? Second, if so, then how do channels transmit the impact of monetary policy to the economy? Finally, which channels effectively transmit monetary policy objectives?

We study this issue by applying the VAR model to estimate impulse response functions and forecast error variance decompositions, focusing on the relationship between money supply and output as well as money supply and price level. First, we estimate a core model to show the overall impact of money supply on the economy. Then we incorporate different transmission channels for monetary policy to isolate their individual roles in terms of how money affects the channel, how the channel affects real output and inflation, and how the impact of money on real output and inflation is changed after controlling for the effects of the channel.

The empirical results indicate that the capability of monetary policy to influence economic activity and inflation is still limited, as operation of important monetary transmission channels are not effective. As in many emerging and transition economies, the exchange rate channel has a stronger impact on economy than other transmission channels in Vietnam.

The paper is organized as follows. Section 2 discusses the channels of monetary transmission and reviews previous empirical works. Section 3 presents the monetary instrument which is applied in Vietnam. Section 4 describes methodology and data. Section 5 presents results and discussion. We conclude the study in Section 6.

2. Literature review on the monetary transmission mechanism

2.1. Monetary transmission channels

The monetary transmission mechanism refers to the process through which changes in a monetary policy instrument (such as aggregate money or short-tem policy interest rates) affect the rest of the economy and, in particular, growth and inflation. Monetary impulse shocks transmit through various channels, affecting different variables and different markets, and at various speeds and intensities. There are four major channels of transmission of monetary policy which have been identified in modern financial systems. The first is through the direct interest rate effects - which affect not only the

cost of credit but also the cash flows of debtors and creditors. The second channel is through the exchange rate. The third channel is through the impact of monetary policy on domestic asset prices – including bond, stock market and real estate prices. Credit availability is the fourth major channel.

Traditional interest rate channel

The traditional Keynesian IS-LM view of the monetary transmission mechanism can be characterized by the following schematic showing the effect of monetary expansion:

M↑ → *Real interest rate(r)* ↓ → *Investment spending* ↑ → *Output* ↑

Although Keynes originally emphasized this channel as operating through businesses' decisions about investment spending, later studies recognized that consumer's decisions about housing and consumer durable expenditure also are investment decisions. Thus, the interest channel of monetary transmission outlined in the schematic above applies equally to consumer spending.

In industrial countries, the interest rate channel generally plays an important role in the transmission of monetary shocks. For instance, according to research done by the European Central Bank (2002), direct and indirect effects of interest rate changes (including wealth and exchange rate effects) on investment explain about 80% of the total response of output to monetary shocks after a lag of three years. In emerging markets, during the 1980s and 1990s there were several impediments to the operation of the interest rate channel. The lack of developed money and bond markets and frequent shifts in the risk premium are examples of such impediments. In some cases, binding interest rate controls combined with non-price mechanisms for allocating credit reduced the pass-through of the policy rate to other interest rates. This may have also reduced the macroeconomic effects of policy rate changes. A greater dependence of firms on the internal cash surplus for financing projects lowered the response of investment to interest rate changes. Limited possibilities for household borrowing restricted the impact of interest rate changes on households as well. As noted above, several of these constraints have eased over the past decade (Mohanty and Turner, 2008).

Exchange rate channel

For countries operating in an international environment, the exchange rate channel may also play an important role in transmitting the effects of monetary policy. Monetary policy can influence the exchange rate through interest rates (via the risk-adjusted uncovered interest rate parity), direct intervention in the foreign exchange market, or inflationary expectations.

An increase in the money supply causes the domestic interest rate to fall. Therefore, assets which are denominated in the domestic currency are less attractive than assets denominated in foreign currencies, resulting in a depreciation of the domestic currency. The depreciation of the domestic currency makes domestic goods relatively cheaper than foreign goods, thereby causing net exports and output to rise.

M↑ → *Interest rate*↓ → *Exchange rate depreciation* → *Net export*↑ → *Output* ↑

In addition to changes in the short-term interest rate, monetary authorities may also influence short-run exchange rate movements by directly intervening on the foreign exchange markets. The unsterilized interventions affect

the exchange rate by altering relative money supplies. Sarno and Taylor (2001) conclude that what emerges from studies focusing on the 1990s is that interventions tend to impact on the exchange rates.

In small open economies with flexible exchange rates, the exchange rate channel is likely to be particularly important because, in contrast to the other channels, it affects not only aggregate demand but also aggregate supply. A loosening of monetary policy, for example, may lead to a depreciation of the exchange rate, an increase in domestic currency import costs, and hence induce firms to raise their domestic producer prices even in the absence of any expansion of aggregate demand. Because exchange rate changes are viewed as a signal of future price movements in many countries, particularly those with a history of high and variable inflation, wages and prices may change even before movements in import costs. When the exchange rate is fixed or heavily managed, the effectiveness of monetary policy is reduced but not entirely eliminated. Often relatively wide margins exist within which the exchange rate can fluctuate. Moreover, if domestic and foreign assets are only imperfectly substitutable, there is some scope for domestic interest rates to deviate from international levels. Therefore, even if the nominal exchange rate is fixed, monetary policy may be able to affect the real exchange rate by acting on the price level. In this manner, monetary policy retains its ability to affect net exports, albeit to a much lesser degree and with much longer lags. However, where domestic and financial assets are close to perfect substitutes, as they may be under currency board arrangements (e.g. in Argentina and Hong Kong) or where there is a long tradition of dollarization (e.g. in Argentina and Peru), the scope for monetary policy is severely limited.

The importance of the exchange rate channel may also depend on the share of domestic value added in tradable goods. If this is high, exchange rate changes have a large effect on output and on demand. But if import content is very high, then the exchange rate will have a more limited impact on domestic product and a large direct impact on inflation instead. In many developing countries - particularly those with only rudimentary markets for bonds, equities and real estate – the exchange rate is probably the most important asset price affected by monetary policy.

Equity price channel

In addition to interest rates and exchange rates, other asset price channels may also play a role. Policy-induced monetary supply changes also affect the level of asset prices, principally those of bonds, equities and real estate in the economy, in accordance with Tobin's *q* theory of investment and through wealth effects on consumption (Mishkin, 1996). With an easier monetary policy stance, equity prices may rise, increasing the market price of firms relative to the replacement cost of their capital. This will lower the effective cost of capital, as newly issued equity can command a higher price relative to the cost of real plant and equipment. Hence, even if bank loan rates react little to the policy easing, monetary policy can still affect the cost of capital and hence investment spending. Policy-induced changes in asset prices may also affect demand by altering the net worth of households and enterprises. Such changes may

trigger a revision in income expectations and cause households to adjust consumption.

M↑ → *Price of equities*↑ → *q*↑ → *Investment*↑ → *Output* ↑

q is defined as the market value of firms divided by the replacement cost of capital.

M↑ → *Price of equities*↑ → *Wealth*↑ → *Consumption*↑ → *Output* ↑

Credit channel

Finally, the credit channel of monetary policy may also be important. In countries with either poorly developed or tightly controlled financial systems, interest rates may not move to clear the market. Aggregate demand is often influenced by the *quantity* of credit rather than its *price*. Even in liberalized, highly developed markets, credit changes operating in addition to interest rate changes have been identified as important factors influencing economic activity. An increasing body of research has found that the financial condition of households, firms and financial institutions can play a key role in the propagation of monetary policy actions (Kamin et al., 1998).

This channel mainly involves agency problems arising from asymmetric information and costly enforcement of contracts in the financial market. The credit channel operates via two main components, including the bank lending channel and the balance-sheet channel.

For bank lending, a decrease in the money supply leads to a decrease in bank deposits, which further decreases the volume of money that banks have to loan out. This, in turn, decreases investment and, ultimately, aggregate demand. This channel allows monetary policy to operate without consideration of the interest rate, meaning that decreasing interest rates may not be sufficient to increase investment. Meanwhile, the balance-sheet channel operates through the net worth of firms. Contractionary monetary policy can reduce the value of assets and raise business costs through higher interest rates, which reduce the net worth of firms. A decrease in the firm's net worth means that lenders must accept less collateral for their loans, which raises the problem of adverse selection and reduces lending for investment spending. Lower net worth also results in the problem of moral hazard because business owners have a lower equity stake in the firm and, therefore, have an incentive to take part in risky projects. As a result, lending and investment spending decreases (Mishkin, 1995).

In countries where private markets for credit either are poorly developed or are prevented by government regulation from operating freely, monetary policy is likely to affect aggregate demand more by altering the quantity or availability of credit than through the direct or indirect effects of changes in the price of credit. This will be true especially when binding controls or guidelines on the quantity of credit itself are present, as is the case in several major developing countries. In addition, binding ceilings on interest rates will force banks to use non-price means of rationing loans and thus enhance the importance of credit availability effects. Finally, direct government involvement in the loan market, either through official development banks or through fiscal subsidies of commercial bank loans, will have a similar effect.

2.2. Empirical works on monetary transmission channels

The empirical studies on the monetary transmission mechanism are numerous and controversial. The efficiency of monetary transmission channels is differential country to country. Taylor (1995) had a survey of the research on interest channels and he took the position that there was strong empirical evidence for substantial interest rate effects on consumer and investment spending. In the other way, the interest rate channel was a strong channel of monetary transmission. However his position was a highly controversial one, because some researchers, for example Bernanke and Gertler (1995), had an alternative view that empirical studies had had great difficulty in identifying significant effects of interest rate through the cost of capital. Indeed these researchers saw the empirical failure of interest rate. In Singapore, Chow (2004) used the real effective exchange rate as a measure for monetary policy and found that output reacted immediately and significantly to a contractionary monetary policy shock. He also found that the exchange rate channel was more effective in transmitting monetary policy to the economy than was the interest rate channel. Kamin et al. (1998) investigated this issue for the emerging market economies and found that in many countries, the interest rate channel was inoperative. However, recently, monetary policy frameworks have become more credible, and central banks more flexible in their operations and interest rate channels have been strengthened (Mohanty and Turner, 2008)

Empirical evidence for transition economies has shown that, although the interest rate channel is the most important transmission channel in industrial countries with developed financial markets, the exchange rate channel is generally the dominant channel of monetary policy transmission in transition economies (Ganev et al., 2002; Egert and MacDonald, 2006; Dabla-Norris and Floerkemeier, 2006). Ganev et al. (2002) attempted to conduct empirical analysis for 10 transition economies using analogous methodology for the same sample period 1995-2000. In this comparative framework a series of Granger causality tests and impulse response analyses were carried out to assess the strength of two major transmission channels: the interest rate and the exchange rate channel. Also in the empirical part, they tried to look for the existence of long-run relationships between the basic set of macroeconomic variables in the countries under investigation. Conventional Granger causality tests showed that for most countries the exchange rate channel was much more stable than the interest rate channel. Domestic currency depreciation could be considered a Granger-cause for core inflation in Bulgaria, the Czech Republic, Estonia, and Romania, and influenced output more often than did the interest rate change. The evidence of long run relationship is found for all of countries in the study with the exception of Estonia and Slovenia. Long run relationship between depreciation and growth turned out positive and significant in many countries while impacts of interest rate on output were not significant in most cases. Investigating the monetary transmission channels in Armenia, Dabla-Norris and Floerkemeier (2006) found that the interest rate channel remained weak, even though there was some evidence for a transmission of shocks to the repo rate to CPI inflation. As in many emerging and transition economies with

a high degree of dollarization, the exchange rate channel appears to have a stronger impact on prices. The empirical analysis has shown that the central bank's means to influence economic activity and inflation were still limited.

In developing economies where most projects are financed by bank loan, the bank lending channel is more effective in explaining the variation in output. Aleem (2010) examined three channels of monetary transmission in India: the bank lending channel, the asset price channel and the exchange rate channel using a VAR model in levels. First, the paper proposed a benchmark VAR model in order to estimate the dynamic responses of GDP, prices and interest rates to an unanticipated monetary policy tightening. After that, the channels were augmented to examine the transmission channels of monetary policy and examined the robustness of the results. Empirical estimates in the augmented VAR model support the importance of the bank lending channel in the transmission of monetary policy shocks to the real sector and suggested that the exchange rate and asset price channels were not important in India. Tsangarides (2010) investigated the transmission mechanism of monetary policy in Mauritius using a VAR framework and suggested that overall the transmission channel was weak, particularly for output. There was evidence that a shock to the repo rate (the primary policy instrument) as well as a shock to the other two policy variables (exchange rate and money supply) resulted in statistically significant changes of the headline CPI and there was a transmission of exchange rate and money supply shocks, but not shocks to the repo rate, on core CPI. These results suggest the possibility that different monetary policy rules could be considered depending on whether headline or core CPI is targeted: for headline CPI where the interest rate channel is stronger, "Taylor-type" rules may be more applicable, while for core CPI, alternative "McCallum-type" rules that target money supply could be more appropriate.

3. Instruments of monetary policy in Vietnam

Vietnam uses a mix of market-based instruments and changes in reserve requirements to carry out monetary policy. The State Bank of Vietnam (SBV) is reducing its reliance on direct instruments, preferring to use indirect instruments. However, given the current level of financial market development and weakness in the monetary transmission mechanism, Vietnamese monetary authorities have no qualms about employing direct instruments to get the job done.

The SBV began introducing indirect monetary policy tools in the mid-1990s as part of financial sector reforms. Today, a number of indirect instruments have been introduced and are increasingly used. The indirect instruments of the SBV consist of reserve requirements, open market operation and central bank lending facilities (refinancing and discount). Open market operations and central bank lending facilities have been used gradually because of the underdeveloped stock market. The SBV uses reserve requirements as the first instrument to implement monetary policy, when there is an inflationary pressure in the economy. For example, in response to inflation in 2004, the SBV, at first, raised the reserve requirement ratio in July. After 6 months, because the inflationary

situation was not improved, the SBV had to raise the rediscount and refinancing rate three times in 2005 and then the base interest rate. Inflation has shown a trend of sharp increase since the middle of 2007. SBV adjusted reserve requirement ratios to increase by 1.5- 2 times (effective since June 2007) in order to withdraw money and control total liquidity growth. Reserve requirement also was employed as one of the effective tools to curb inflation during 2008.

The SBV has two lending facilities, a refinancing and a discount facility. Both are collateralized and the latter gives commercial banks access to funds subject to quotas. Discount operations can take the form of an outright purchase of securities or a repurchase agreement. Recently, in the early months of 2008, the SBV actively used both the refinance and discount rates in the process of tightening monetary policy to fight high inflation.

Apart from reserve requirements, refinancing and discount lending facilities, the SBV uses open market operations and foreign exchange interventions. Open market operations, which started in July 2000, had to be developed from scratch. Over the years, they have gained in importance and have by now become the single most important monetary instrument for controlling liquidity. The SBV also employs interventions in the foreign exchange market through purchases and sales of foreign currency or foreign exchange swaps. These interventions have been substantial at times of recession or inflation pressure. The main purpose of foreign exchange interventions has been to achieve the foreign exchange target set by the SBV. The exchange rate policy aims at promoting exports, limiting imports, attracting capital inflows and accumulating foreign exchange reserves. The SBV has always paid much attention to maintain a favorable exchange rate for exporters because the economic growth is led by export.

Beside indirect monetary policy instruments, the SBV continues to use measures to influence interest rates and credit more directly. For example, in March 2008, to realize inflation control targets, the SBV issued VND 20,300 billion of compulsory SBV bills with 364 - day maturity at 7.8% per annum, and instructed credit institutions not to use them in refinancing operations with the SBV. As of October 1, 2008, however, to support liquidity of credit institutions in the context of the global financial crisis, the SBV allowed credit institutions to use compulsory SBV bills in applying for refinancing loans and allowed prepayment for those bills at the same time. Furthermore, in the early part of 2008, commercial banks' lending interest rate was rather high (about 18.5-19% in March 2008). SBV issued an interest rate regulating mechanism requiring that the maximum VND lending rate be 150 percent of the base interest rate. From December 31, generally, the VND lending rate remained at 10.8-11.5%, 12-12.75% and 8.5- 10% per annum for short-term, medium and long-term and preferential loans, respectively (SBV, 2008). In 2009, SBV implemented a strong expansionary policy with an interest rate support lending policy where a cutting - off 4% interest rate applied for short-term and medium-and long term loans from banks for certain sectors, which covered mainly non-stated own enterprises (69%). Therefore, the borrowers could gain benefit directly

by the decreased cost of capital.

4. Methodology and data

In recent years, VAR analysis has been used extensively to examine the effect of monetary policy on output and prices in developing and transition countries (see Ganev et al., 2002; Starr, 2005; Hericourt, 2005; Mohanty and Turner, 2008; Aleem, 2010). This approach is popular because of its lower requirement with respect to data and due to the possibility of working with a looser underlying assumption. In the case of transition economies, VAR estimation is also a useful methodological approach with good predictive power (Asel, 2008). In addition, the VAR technique is one of the most useful tools in illustrating a macro view of interrelation among all channels of a transmission mechanism. In particular, the effects of a shock to one of the variables on all the other variables of the system can be inferred from the impulse responses of the VAR model. However, as the innovations in the model are usually contemporaneously correlated, a transformation to derive a diagonal contemporaneous covariance matrix is necessary.

Macroeconomic time series are often characterized by a high degree of persistence. Frequently, the persistence is well described by a so-called unit root process. In such cases, at least some shocks have a permanent effect on x_t, i.e. x_t is non-stationary, and standard asymptotic results may not be applicable (Ender, 1995). Therefore, we first determine the order of integration or the stationary of each series by applying Augmented Dickey-Fuller (ADF) unit root tests. If the series do not have the same order of integration, we must establish transformation. If the order of integration of the series is the same, Johansen's cointegration test is applied to assess whether these series are cointegrated (Johansen, 1991). If there is evidence of cointegrating relationships, the system could be estimated either in levels or in a vector error correction form. The latter approach required identification and the imposition of restriction and is better suited for exploring the long-run relationships. Since the monetary transmission mechanism is a short-run phenomenon, most like studies employ unrestricted VARs in level to evaluate impulse response over the short to medium term (Favero, 2001; Dabla-Norris and Floerkemeier, 2006; Tsangarides, 2010). The lag length of VAR models will be selected on the basis of adjusted Likelihood Ratio (*LR*) test for small sample discussed in Lutkepohl (1991).

Based on estimated VAR models, impulse response functions and forecast error variance decompositions of each dependent variable are computed. Impulse response functions show how a shock to one variable is followed by changes in the other variables over several periods of time, once the effects of all variables in the model are accounted for. The forecast error variance decomposition for each variable reveals the proportion of the movement in this variable due to its own shocks versus the shocks in other variables. Therefore, impulse response functions show the direction of the dynamic response of the variables to different innovations, the variance decompositions provide the magnitude of the response to the shocks.

In this paper, the recursive Choleski decomposition scheme is applied. The coefficient matrix of innovations is simply a lower triangular matrix. The contemporaneous effects of shocks

are implied in the order of the variables in the VAR. Therefore, with an inappropriate order of variables, the recursive orthogonalization of the error terms for impulse response analysis can lead to "puzzles". First, we estimate a core VAR model with the order of endogenous variables: output (*IO*), price (*CPI*), and money supply. This ordering reflects the fact that a change in the money supply would affect output and price through the channels. However, the impact of money supply on output and price cannot be done at the same period due to policy lags. Therefore, a shock to the money supply would be transmitted to the price level and output in the next period. We use the broad money variable *M2* as a proxy for monetary policy shocks because the growth rate of M2 is considered as an operating target in formulating and implementing monetary policy at the State Bank of Vietnam (Le and Pfau, 2009). After that, we add additional variables to examine the effects of specific channels, namely the interest rate channel, the exchange rate channel, asset channel, and the credit channel. The framework is based on the following variable ordering: *IO, CPI, M2*,*"Channel"*.

For the interest rate channel, we note that the prime interest rate that the State Bank frequently announces does not reflect the supply of and demand for money in the money market. Rather, it serves as a reference rate for commercial banks in setting their own deposit and lending rates. Therefore, prime interest rates do not seem to be a suitable representative of the monetary policy stance in Vietnam. Consequently, we use real lending rate (*LR_R*) to investigate the effectiveness of monetary policy through the interest rate channel. To explore the monetary transmission mechanism through the exchange rate channel, previous studies use both nominal and real exchange rate variables. Therefore, this study applies both nominal and real effective exchange rate (*NEER* and *REER*) to investigate whether the exchange rate channel is really stronger than the others in transition economies as the results of previous studies.

For the exchange rate channel, first, we investigate this channel without considering the impact of the interest rate on changes in the exchange rate because there is the existence of capital controls in Vietnam which mean that the exchange rate is not sensitive to the interest rate. After that, we revisit the exchange rate channel by incorporating the interest rate as the channel to transmit the effect of money supply on the exchange rate to examine the role of the interest rate and the robustness of our results. In the model with NEER, we use the nominal lending rate (*LR*) according to the uncovered interest rate parity theory while the real interest rate is incorporated in the model with REER.

The role of the equity channel is investigated through the stock price index (*VNI*). Finally, the domestic credit level (*CREDIT*) is used to recognize the position of the credit channel in the Vietnamese economy.

Monetary policy transmission channels in Vietnam are investigated by using monthly data for the period from January 1995 to October 2009 with the exception of the asset channel starting from July 2000 and interest rate channel starting from January 1996, due to available data. Data of real industrial output is collected from GSO. Data of money supply and stock market price are obtained from SBV. Nominal

and real effective exchange rates are calculated based on the relative price and trade-weighted with 20 largest trading partners (Data for calculations are obtained from IFS and DOT of IMF). The other data are collected from IFS of IMF.

All data are expressed in natural logs and seasonally adjusted, with the exception of the lending rates, which is in levels and not seasonally adjusted.

5. Results and discussion

Unit root test

Individual time series properties of the data are tested using Augmented Dickey-Fuller unit root tests. As Table 1 shows, at 5 percent level of significance, all series are nonstationary in the cases of *constant* and *constant & trend* with exception of the real lending rate which is stationary in the case of *constant & trend*. However, these series are stationary after taking first differences. In other words, all of the variables are the same integrated order one, i.e. I(1). Then we investigate whether these variables are cointegrated by using Johansen's cointegration test.

Cointegration tests

Table 2 shows the results of the cointegration test. The test reveals that the variables in all models are cointegrated. There is one cointegration vector in all of the models with the exception of the models of the exchange channel which take account of the transmission of interest rate.

These results suggest that there exist cointegrating relationships among variables. Therefore the system can apply VARs in levels to compute impulse response functions and variance decompositions.

Impulse response functions

Figure 1 and Figure 2 present impulse response functions indicating the impact of money supply on output and price in the models with and without the transmission channels, respectively.

The core model shows that an increase in money supply enhances economic growth immediately and causes inflation after one year.

Table 1: ADF tests for unit root

Variables	Levels		First differences	
	Constant	Constant&trend	Constant	Constant&trend
M2	0.09	-2.69	-5.83	-5.81
CPI	2.30	0.53	-3.33	-4.06
IO	0.35	-1.48	-7.30	-7.30
LR	-2.56	-2.15	-6.15	-5.62
LR_R	-1.14	-3.83	-3.92	-3.95
NEER	0.14	-2.35	-10.31	-10.51
REER	-2.21	-2.26	-10.11	-10.09
VNI	-2.04	-3.28	-6.36	-6.37
CREDIT	2.34	-2.43	-7.28	-7.31

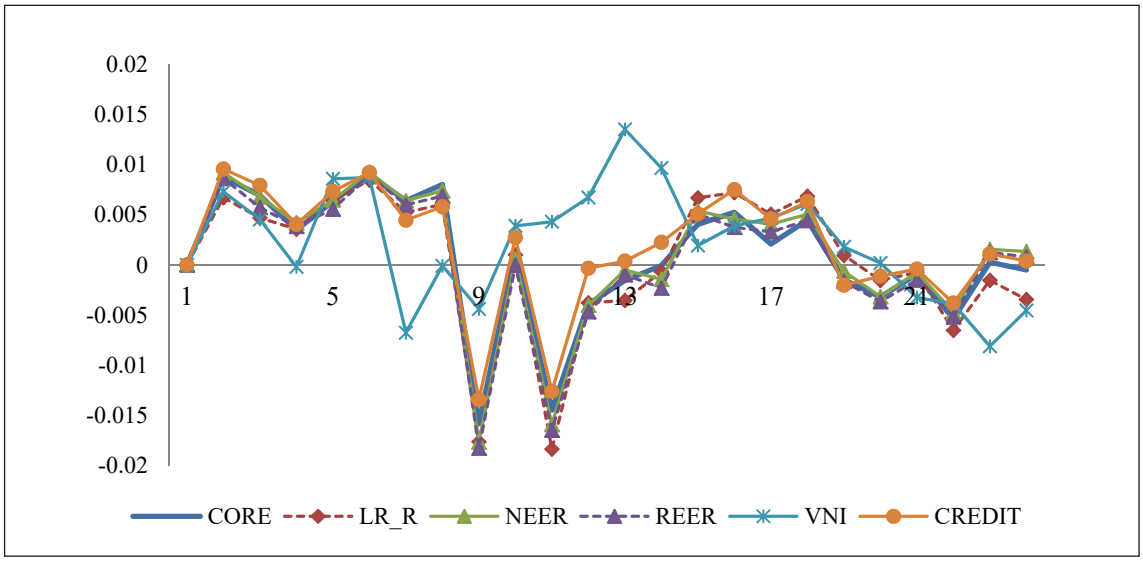
Note: At the 5% level of significance, the critical value for each test with constant is -2.88 and with constant & trend is -3.44

Table 2: Cointegration tests

Hypothesized No. of CE	Eigenvalue	Trace test		Max-Eigen test	
		Statistic	*5% Critical value*	*Statistic*	*5% Critical value*
Core Model (11)					
None *	0.19	47.91*	35.19	35.16*	22.30
At most 1	0.05	12.75	20.26	8.96	15.89
At most 2	0.02	3.79	9.16	3.79	9.16
Interest rate channel (11)					
None *	0.46	120.88*	47.86	92.15*	27.58
At most 1	0.10	28.73	29.80	16.28	21.13
At most 2	0.07	12.45	15.49	10.76	14.26
At most 3	0.01	1.69	3.84	1.69	3.84
Exchange rate channel					
With NEER (11)					
None *	0.26	77.65*	54.08	51.18*	28.59
At most 1	0.08	26.46	35.19	13.86	22.30
At most 2	0.05	12.61	20.26	8.57	15.89
At most 3	0.02	4.04	9.16	4.04	9.16
With REER (11)					
None *	0.27	78.42*	54.08	52.95*	28.59
At most 1	0.08	25.46	35.19	13.04	22.30
At most 2	0.05	12.42	20.26	8.69	15.89
At most 3	0.02	3.74	9.16	3.74	9.16
Asset price channel (11)					
None *	0.35	73.41*	47.86	43.09*	27.58
At most 1	0.15	30.32*	29.80	15.90	21.13
At most 2	0.13	14.42	15.49	14.29	14.26
At most 3	0.00	0.13	3.84	0.13	3.84
Credit channel (11)					
None *	0.18	65.70*	54.08	33.61*	28.59
At most 1	0.11	32.09	35.19	18.53	22.30
At most 2	0.04	13.56	20.26	7.48	15.89
At most 3	0.04	6.08	9.16	6.08	9.16
Exchange rate channel via interest rate					
NEER and LR (12)					
None *	0.47	158.79*	69.82	93.09*	33.88
At most 1 *	0.20	65.71*	47.86	33.06*	27.58
At most 2 *	0.14	32.64*	29.80	21.59*	21.13
At most 3	0.07	11.05	15.49	10.98	14.26
At most 4	0.00	0.07	3.84	0.07	3.84
REER and LR_R (12)					
None *	0.55*	199.24	69.82	115.96*	33.88
At most 1 *	0.28*	83.27	47.86	47.47*	27.58
At most 2 *	0.13*	35.80	29.80	20.39*	21.13
At most 3	0.09	15.41	15.49	14.22	14.26
At most 4	0.01	1.19	3.84	1.19	3.84

*Note: * means that the null hypothesis is rejected at a 5% significance level. Optimal lags are show in parentheses.*

Figure 1: Response of output to monetary shocks through difference channels
(Cholesky One S.D. Shocks)



The positive impact of money supply shocks on output is maintained for around 8 months after the initial shock. After augmenting the channels of monetary transmission, the positive impact of money supply shocks on output follows the same road and is stronger in models with credit channels while weaker in the model with the interest rate channel. An increase in money supply affects price faster and stronger in all models with the transmission channels except in the credit channel. It seems that through the stock price channel the changes in money sup-

Figure 2: Response of price to monetary shocks through difference channels
(Cholesky One S.D. Shocks)

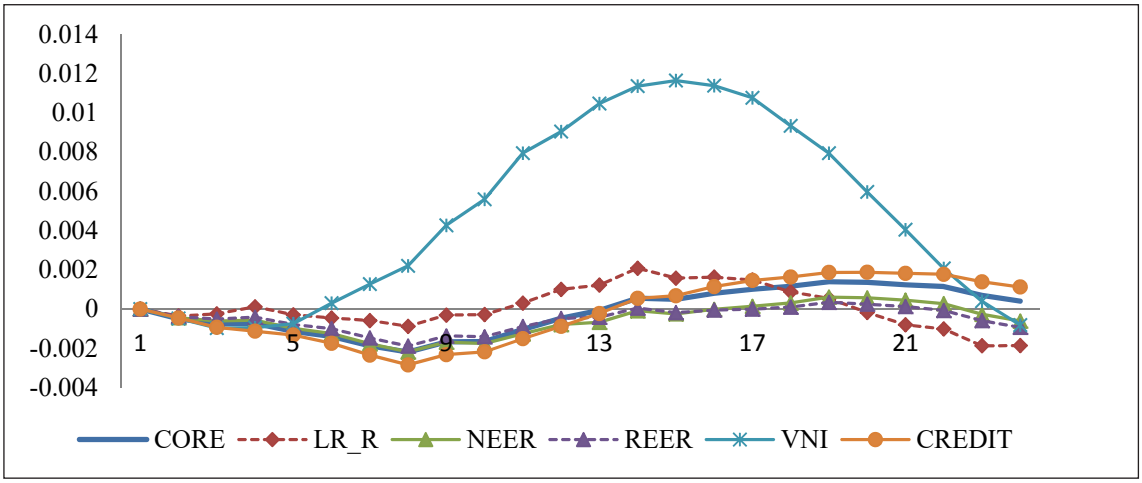
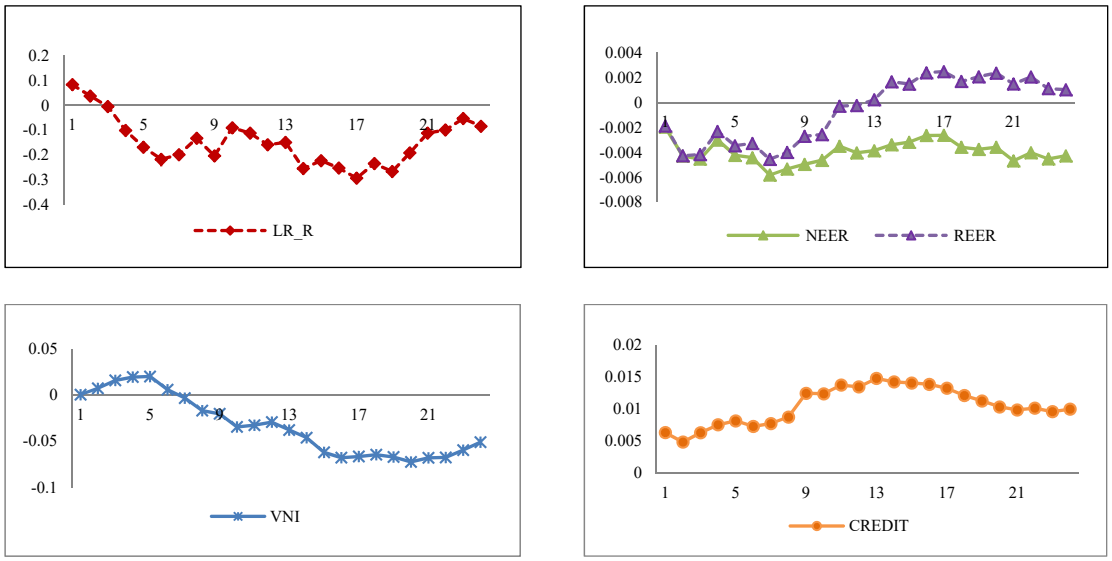


Figure 3: Response of channels to monetary shocks



ply cannot transmit to output but amplify the effect on inflation.

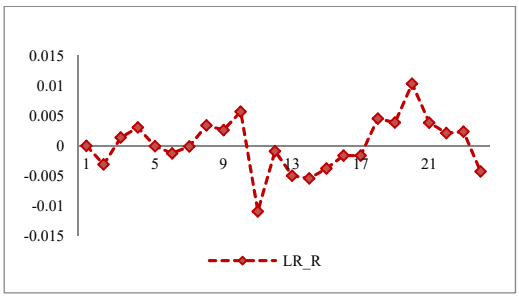
Figure 3 shows the effect of monetary shocks on the channels. A one-standard deviation shock to money supply leads to an immediate increase in the stock market price, and domestic credit, and depreciates domestic currency in both nominal and real terms. However, after 5 quarters, the real exchange rate tends to appreciate because of the increase in domestic price. The responses of the real lending rate to the shocks of money supply are slower and take about 3 months to decline. Among them, the impact of money supply on domestic credit is stable and clearly significant.

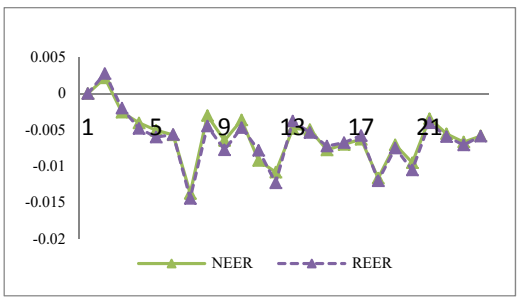
Figure 4 presents the impact of each channel on output and price. As expected, an increase in lending rate or appreciation or a decline in domestic credit harms economic growth and decreases the price. Among the channels, the impacts of the exchange rate channel on output and price are revealed as expected and the credit channel is followed. The shocks of the lending rate and stock price to output and price level are not clearly significant. The impact of the stock price on both output and price seem to be a "puzzle", however, its impact is weak. The response of price level to an increase in stock price is positive after one year.

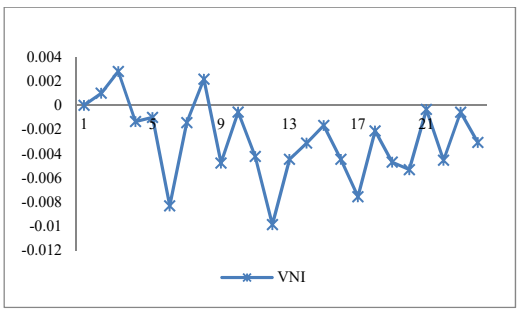
In general, the credit and exchange rate channels are better than the others for transmitting the impact of money supply on economic growth and price level. The results of impulse response functions suggest that although the interest rate channel is not effective for monetary transmission to output but has an important role in the disinflation period. The monetary transmission through the stock price channel is inefficient and contains latent risks because the stock market in Vietnam is rudimentary and the monetary impact on inflation is amplified via this channel.

Figure 4: Response of output and price to shocks of channels

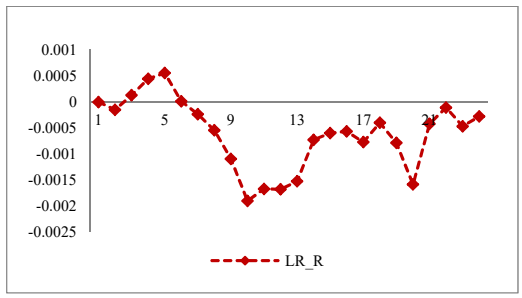
Response of Output

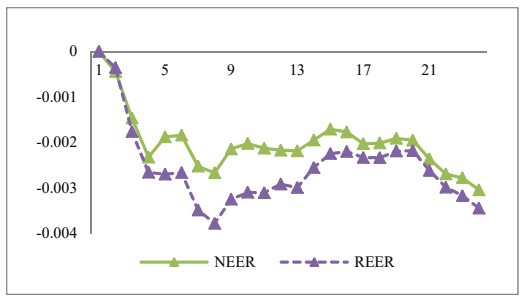


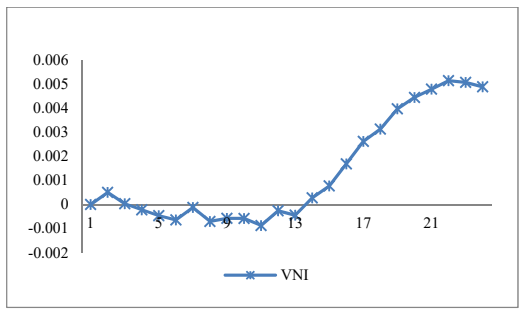


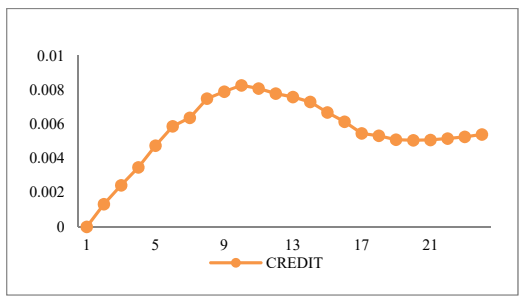


Response of Price









Variance decompositions

Table 3 presents the share of fluctuations in the output and price that are caused by difference shocks by calculating variance decompositions at forecast horizons of 24 months.

The results of variance decompositions show that money supply is an important source of the variance in output but not in price. At the 12-month horizon, money supply accounts for nearly 20% of the variance in the output and about 1% of the variance in the CPI. However, at a horizon of 24-months, the role of money supply in both variations of output and price decreases. These findings are consistent in the models augmenting the monetary transmission channels with the exception of the asset price channel where money supply explains 62.85% in the variation of price and only 17.52% in the variation of output at 24-month horizons. The impact of money supply is strengthened on output through the exchange rate channel (where money supply accounts for more than 20% of the variation of output) and on price through the stock price channel (where money supply accounts for about 40% of the variation of price).

Among the channels, exchange rate channel have contributed to a greater extent than other channels to the movement of output, while credit channels are important sources of the shocks in inflation. After 24 months, the real (nominal) exchange rate accounts for 20.19% (18.55%) in the variation of output, while stock price, domestic credit, and interest rate only account for 8.82%, 6.52%, and 6.24% in the variation of output, respectively. However, domestic credit accounts for more than 20% of the variation in price. The interest rate channel has a weak role in the variation of both output and price.

Table 3 also shows that money supply is an important contributor in explaining the variation of the credit channel. After one year, the shocks of money supply account for 31.29% of the variation of domestic credit while it accounts for less than 5% of the variation of the other channels. The role of money supply in the variation of the interest rate increases after 2 years but is still small with the 4.45% variation of interest rate explained by money supply.

In general, the analysis of variance decompositions finds that, in the short run, money supply and exchange rate have important roles in running the economic growth objective. In periods of high inflation, the controlling of the central bank in domestic credit as well as in money supply is necessary to achieve the monetary objective. The stock price is considered as a potential channel of monetary transmission in the future.

Revisiting the exchange rate channel with impact of interest rate

As explained above, to investigate the role of the interest rate in monetary transmission through the exchange rate channel, as well as to check the robustness of the results of the exchange rate channel, we add the interest rate variable in the models of the exchange rate channel because we consider the interest rate as one of the channels transmitting the impact of money supply to the exchange rate.

Figure 5 presents impulse response functions of output and price to Cholesky one standard deviation innovations of money, interest rate and exchange rate. The results confirm the discussions on the shocks of money supply

Table 3: Variance decompositions

Variables	Decompositions					
	Period	S.E.	IO	CPI	M2	Channel
	Core model					
IO	12	0.07	76.92	4.25	18.83	
	24	0.07	74.09	8.75	17.16	
CPI	12	0.04	0.14	98.81	1.06	
	24	0.06	3.64	95.55	0.82	
M2	12	0.09	7.59	17.91	74.50	
	24	0.12	9.61	16.09	74.30	
	Interest rate channel					
IO	12	0.07	73.09	5.91	17.34	3.66
	24	0.09	61.72	16.09	15.95	6.24
CPI	12	0.04	1.12	98.00	0.18	0.70
	24	0.06	8.16	90.18	0.82	0.85
M2	12	0.07	13.99	22.04	63.12	0.84
	24	0.09	10.12	35.17	53.80	0.92
LR_R	12	3.26	1.22	89.16	2.22	7.39
	24	4.01	6.65	82.27	4.45	6.63
	Exchange rate channel					
IO	12	0.07	61.66	5.84	20.72	11.78
	24	0.08	50.87	12.91	17.67	18.55
CPI	12	0.04	0.12	96.63	0.97	2.29
	24	0.06	1.51	95.14	0.57	2.79
M2	12	0.09	8.19	17.14	74.10	0.57
	24	0.12	9.09	16.01	74.44	0.46
NEER	12	0.04	1.46	0.83	2.97	94.74
	24	0.05	1.48	3.64	6.48	88.40
IO	12	0.07	59.92	5.99	20.47	13.62
	24	0.08	48.58	14.00	17.22	20.19
CPI	12	0.05	0.07	94.90	0.63	4.40
	24	0.06	1.46	93.66	0.38	4.50
M2	12	0.09	6.65	19.44	73.72	0.19
	24	0.12	6.84	18.71	73.09	1.36
REER	12	0.05	1.59	42.74	4.62	51.05
	24	0.06	1.42	57.80	4.34	36.44
	Asset price channel					
IO	12	0.06	74.47	7.99	10.86	6.68
	24	0.07	62.42	11.24	17.52	8.82
CPI	12	0.02	3.00	56.62	39.80	0.58
	24	0.04	6.47	21.01	62.85	9.67
M2	12	0.04	6.80	4.47	78.37	10.36
	24	0.05	7.87	14.55	64.96	12.62
VNI	12	0.33	19.14	27.86	4.41	48.59
	24	0.45	16.19	28.47	24.99	30.35
	Credit channel					
IO	12	0.07	73.55	4.41	15.26	6.78
	24	0.08	66.80	11.92	14.76	6.52
CPI	12	0.04	0.80	74.07	1.84	23.29
	24	0.06	1.39	74.80	1.52	22.29
M2	12	0.09	21.20	5.95	62.38	10.47
	24	0.13	27.11	3.28	52.68	16.93
CREDIT	12	0.06	18.85	5.96	31.29	43.89
	24	0.09	34.49	4.62	38.90	21.99

Figure 5: Impulse response functions - exchange rate channel with interest rate

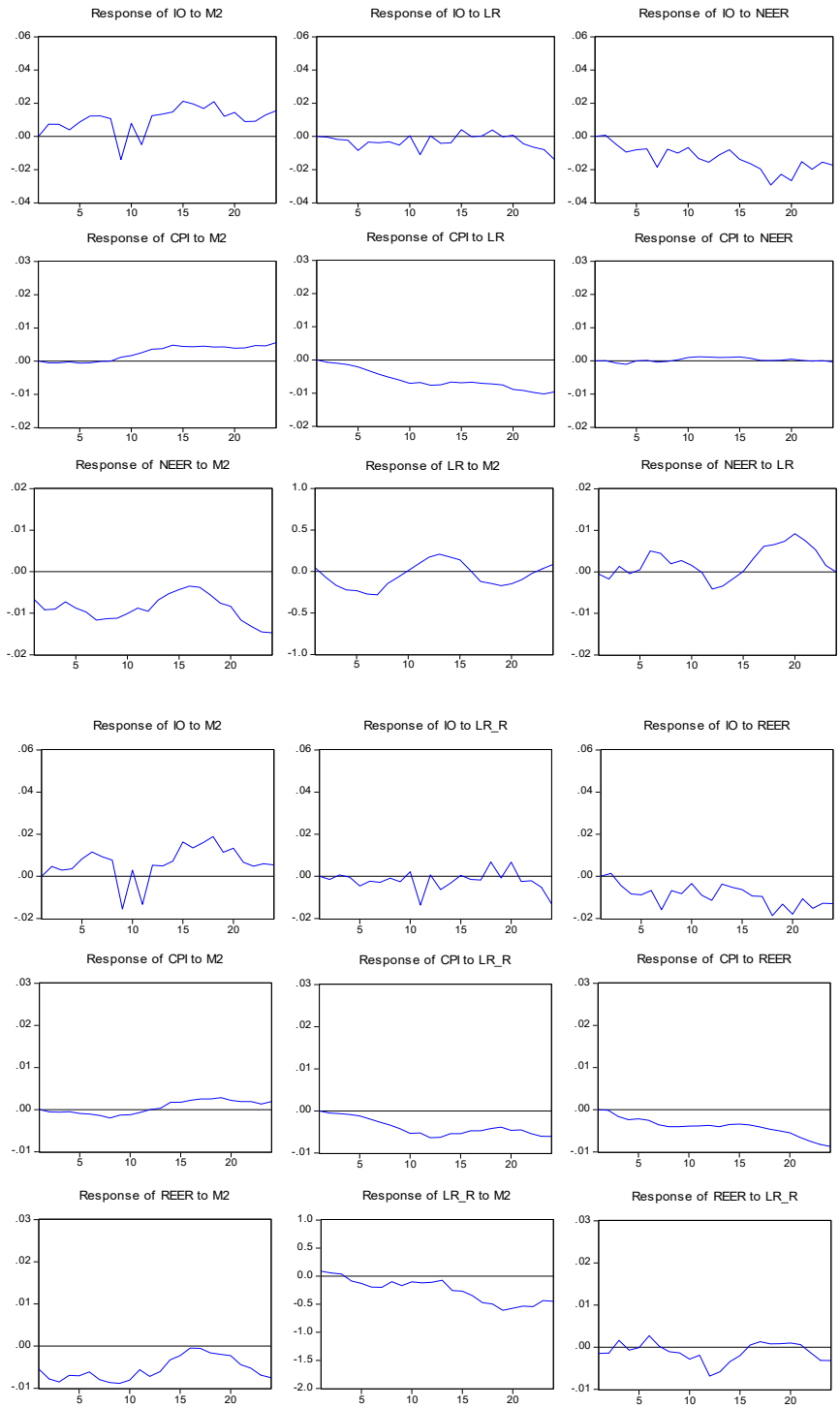


Table 4: Variance decompositions-exchange rate channel with interest rate

Variables	Decompositions						
	Period	S.E.	IO	CPI	M2	Interest rate	Exchange rate
IO	12	0.07	59.88	6.59	17.33	3.33	12.87
	24	0.09	47.19	6.73	19.49	5.20	21.39
CPI	12	0.04	0.67	91.58	0.30	5.51	1.95
	24	0.06	3.13	84.56	0.73	5.21	6.37
M2	12	0.06	6.14	30.77	50.43	1.15	11.51
	24	0.10	2.89	29.80	33.47	2.47	31.37
LR	12	2.07	3.02	59.86	7.37	24.97	4.79
	24	2.60	4.11	55.78	8.10	25.70	6.31
NEER	12	0.04	4.31	1.92	18.50	4.24	71.03
	24	0.05	5.01	13.36	19.37	9.88	52.38
IO	12	0.07	60.27	7.35	16.97	3.62	11.79
	24	0.09	44.37	14.71	18.09	5.78	17.05
CPI	12	0.04	2.75	91.62	0.37	3.47	1.79
	24	0.05	9.68	83.85	1.69	2.98	1.80
M2	12	0.06	3.96	22.69	68.37	0.59	4.39
	24	0.10	2.38	36.23	48.68	0.89	11.83
LR_R	12	3.34	2.23	86.68	1.31	7.59	2.20
	24	4.44	5.75	81.55	1.37	8.77	2.55
REER	12	0.04	3.46	25.40	13.27	3.85	54.02
	24	0.05	4.35	41.55	11.88	4.62	37.60

and exchange rate to output and price above. An increase in money supply and depreciation promote economic growth but cause inflation. There exist transmission mechanisms from money supply to interest rate and from interest rate to exchange rate. An increase in money supply decreases the interest rate and hence it follows that the exchange rate depreciates. However, because of the existence of capital control and dollarization in Vietnam, the impact of the interest rate on the exchange rate is not stable. Even though the real interest rate increases, sometime the exchange rate still depreciates in both nominal and real terms.

Table 4 shows the estimations of variance decomposition through 24 months. Variance decompositions also confirm the discussions above of the role of money supply and exchange rate in the variation of output and price. Unsurprisingly, money supply has a more important role than the interest rate in the variation of the exchange rate. Money supply accounts for approximately 20% of the variation in the nominal exchange rate, whereas the interest rate contributes only around 10% of the nominal exchange rate variation. This result proves the fact that SBV has directly intervened in the interbank foreign exchange market and has affected the exchange rate by altering relative money supplies to maintain the fixed exchange rate regime.

6. Conclusion

This paper investigates the mechanism of monetary transmission in Vietnam through four major channels - namely the interest rate channel, the exchange rate channel, the asset channel and the credit channel for the period of 1995-2009 with monthly data. Because there is evidence of cointegrating relationships, this study applies VARs in levels to estimate impulse response functions and variance decompositions.

The empirical results show that the changes in money supply have an impact on output rather than price in the short run. This impact is strengthened through the exchange rate and the credit channel and weakened through the interest rate channel. However, the impact of monetary policy may be erroneous through the asset price channel because of the lack of an established and well-functioning stock market. The change in money supply can affect the channels of monetary transmission as expected, however it is still weak with the exception of the exchange rate and credit channels.

The study finds that the impacts of the channels on output and price are as expected. Among them, the exchange rate channel has impact on both output and price; but its impact on output is larger. The linkage between money supply and the exchange rate is revealed after considering the interest rate as a transmission channel from money supply to exchange rate even though capital control still exist in Vietnam. This results from the existence of dollarization in the economy. The existence of dollarization leads to a higher exchange rate pass-through. The efficiency of exchange rate channel is declined due to the appreciation of the real exchange rate. Therefore, dedollarization is necessary to improve the efficiency of the exchange rate channel.

In contrast, the other channels affect price more significantly than output, especially the credit channel. Therefore, in periods of high inflation, controlling domestic credit plays an important role in stabilizing price level. The interest rate channel is not efficient for monetary transmission however an increase in interest rate will contribute to controlling inflation in Vietnam. The response of the interest rate to monetary shock is slow and so the SBV controlling directly interest rates is necessary in cases of emergency.

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