VAR ANALYSIS OF THE MONETARY TRANSMISSION MECHANISM IN VIETNAM

LE, Hung V.[*]
PFAU, Wade D.

Abstract

Understanding the monetary transmission mechanism is crucial to central bankers. We analyze the monetary transmission mechanism in Vietnam, using the vector autoregression approach (VAR) and focusing on the reduced-form relationships between money, real output, price level, real interest rate, real exchange rate and credit. We find consistent evidence that monetary policy can affect real output. Surprisingly, the connection between money and inflation is less clear in the Vietnam case. As for the transmission mechanism, the credit and exchange rate channels are more important than the interest rate channel.

Keywords: Monetary policy, transmission mechanism, vector autoregression, Vietnam
JEL Codes: E52, E58, C32

1. Introduction

Monetary policy is a powerful tool for impacting the economy, therefore it is crucial to have a good understanding of the channels through which monetary policy is transmitted. Theory indicates that an increase in the money supply should lead to an increasing price level and may potentially increase real output. This can occur through a variety of channels including the interest rate channel, the credit channel, the exchange rate channel, and the asset price channel (Mishkin, 2006).

Thus far, the monetary transmission mechanism in Vietnam has not been studied quantitatively. Using an expression from Bernanke and Gertler (1995), the mechanism remains a "black box" to monetary policymakers at the State Bank of Vietnam. This creates difficulties in formulating and implementing monetary policy, as the significance, effect and timing of each transmission channel is not quantified. Therefore, an empirical study of the monetary transmission mechanism is timely and useful, revealing many important policy implications for Vietnam, such as whether monetary policy should target output or inflation.

In this paper, we address several questions. First, does an increase in the money supply affect real output and the price level in Vietnam? Second, if so, then by what channels is the impact transmitted to the economy? Finally, how long does it take for the different channels to operate?

We study these issues with the vector autoregression (VAR) approach, focusing primarily on the reduced-form relationships between monetary policy and output using a small number of variables such as real output, price level, money supply, real interest rate, credit in the economy, and real effective exchange rate (REER). First, we estimate a

[*]Hung V. Le, Expert, Foreign Exchange Department, State Bank of Vietnam, 49 Ly Thai To, Hanoi, Vietnam. E-mail: lvhung@sbv.gov.vn or hunglv73@yahoo.com and Wade D. Pfau Associate Professor, National Graduate Institute for Policy Studies (GRIPS), 7-22-1 Roppongi, Minato-ku, Tokyo 106-8677, Email: wpfau@grips.ac.jp

basic model to show the overall impact of money on the macroeconomy. Then, we add different transmission channels for monetary policy to isolate their individual roles in terms of how money impacts the channel, how the channel impacts 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 basic VAR model indicates that the money supply Granger causes real output but not inflation. From the impulse response functions, we see that the relationship between money and output is positive for the first seven quarters, except for a temporary dip in the third quarter after the shock. From the basic model, we add different channels for monetary policy to determine which channels play an important role. For the interest rate channel, we find little effect as the money supply continues to Granger cause real output while controlling the impact of interest rates does not change the relationship between money and output. As for the exchange rate channel, its inclusion causes money and inflation to Granger cause real output, and the real exchange rate just misses causality at the five percent significance level. Controlling for the real exchange rate also weakens the remaining relationship between money and output. Finally, we find the credit channel is also important and explains much of the way in which money affects output, as it is actually credit that Granger causes the money supply. The credit channel is more important than the interest rate channels for Vietnam. Also it is interesting to note the lack of relationship between money and inflation in Vietnam, as inflation is driven by other factors. To complete the analysis, we review the relevant literature, describe the institutional framework for monetary policy in Vietnam, describe our data and methodology, and then provide our results and conclusions.

2. Literature Review

An examination of the existing literature leads us to first consider the variety of potential channels or links in which the monetary transmission mechanism may work, and then to consider empirical studies of the transmission mechanism for different countries.

Channels of the Monetary Transmission Mechanism

The most basic channel of monetary transmission is known as the "interest rate channel." According to Mishkin (2006), an expansionary monetary policy (i.e., increasing the money supply) causes the real interest rate to fall through the liquidity effect. This reduces the cost of capital, which in turn induces businesses to increase spending on investments and consumers to increase their housing and durable expenditures. The increase in spending results in a larger aggregate demand and total output for the economy.

For countries operating in an international environment, the exchange rate channel may also play an important role in transmitting the effects of monetary policy. According to Mishkin (2006), an increase in the money supply causes the domestic real 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 domestic currency. The depreciation of the domestic currency makes domestic goods relatively cheaper than foreign goods, thereby causing net exports and output to rise.

In addition to interest rates and exchange rates, other asset price channels may also play a role. Important among these is the role of stock prices, which may affect the economy in accordance with Tobin's q theory of investment and through the effects of stock market

wealth on consumption (Mishkin, 1995). But we do not describe these channels further, because the stock market in Vietnam was only just established in 2000 and has been, thus far, subjected to speculative pressure from domestic investors. It is too early for a proper investigation of this channel.

Finally, the credit channel of monetary policy may also be important. 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 (Mishkin, 1995).

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 reduces 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). With this situation, it may take longer for an expansionary policy to have an impact.

Empirical Analysis of the Monetary Policy Transmission Mechanism

With theory suggesting a wide variety of potential channels for monetary policy, researchers must turn to the data to see what is important for a particular country. The analytical framework for the monetary transmission mechanism has been set forth in several studies, such as Taylor (1995), which proposes an empirical framework for analyzing the mechanism and finds several policy implications. Studies that look at the transmission mechanism in the United States include Bernanke and Blinder (1992) and Bernanke and Gertler (1995). More broadly, Hsing (2004) studies the case of Argentina; Goh, Chong, and Yong (2007) look at the bank lending channel in Malaysia; Morsink and Bayoumi (2001) provide an analysis of Japan's stance; Disyatat and Vongsinsirikul (2003) analyze the monetary policy and the transmission mechanism in Thailand; Poddar, Sab, and Khatrachyan (2006) study the monetary transmission mechanism in Jordan, and Hwee (2004) looks at the case of Singapore.

Generally speaking, these studies mainly use a VAR approach and focus primarily on the reduced-form relationships between monetary policy and output using a small number of variables, such as real output, inflation, interest rates, credit growth, REER, foreign reserves, and a stock market index. We consider a few of these studies in greater detail to obtain a better idea about their methods and findings.

First, Morsink and Bayoumi (2001) use VAR models with quarterly, seasonally-adjusted data from 1980Q1 to 1998Q3, using two lags to analyze the effect of monetary shocks on the Japanese economy. In their basic model, they use economic activity, prices, interest rates, and broad money. They find that both the interest rate and broad money significantly affect output. Then, after examining the basic model, they extend the VAR

to include different channels of the monetary transmission mechanism and conclude that both monetary policy and banks' balance sheets are important sources of shocks to output, that banks play a crucial role in transmitting monetary shocks to economic activity, and that business investment is especially sensitive to monetary shocks.

In their analysis, Disyatat and Vongsinsirikul (2003) also use the VAR approach with quarterly, seasonally-adjusted data from 1993Q1 to 2001Q4 with two lags to analyze the monetary transmission mechanism in Thailand. Their basic model includes real output, the price level, and the fourteen-day repurchase rate, which they assume to be the measure of monetary policy. They find that tightening monetary policy leads to a decrease in output, which bottoms out after around 4–5 quarters and dissipates after approximately eleven quarters. The aggregate price level initially responds very little, but ultimately starts to decline after about a year. Investment appears to be the most sensitive component of gross domestic product (GDP) to monetary policy shocks. Their findings were consistent with those of other countries and with what monetary theory suggests.

Finally, in Singapore, Hwee (2004) uses the real effective exchange rate as a measure for monetary policy and finds that output reacts immediately and significantly to a contractionary monetary policy shock. He also finds that the exchange rate channel was more effective in transmitting monetary policy to the economy than was the interest rate channel.

3. Legal and Institutional Framework for the Conduct of Monetary Policy in Vietnam

Legal Framework

The legal framework for the State Bank of Vietnam was formed by the "Law on the State Bank of Vietnam" (enacted in 1996 and amended in 2003) and other regulations. According to the law, the State Bank is a government agency and the central bank of the Socialist Republic of Vietnam. The State Bank is responsible for exercising state management in the monetary and banking fields and acts as the currency issuing bank, the bank of credit institutions, and the bank of the government. Its activities aim at stabilizing the value of the currency, safeguarding banking activities and the banking system, and contributing to socio-economic development within the context of the country's socialist orientation. Headquartered in Hanoi, it is a legal entity whose capital belongs to the state (State Bank of Vietnam [SBV], 2003).

As stipulated by the "Law on the State Bank of Vietnam," the process of monetary policy formulation involves the National Assembly, the Government, the National Monetary Policy Advisory Board (NMPAD), and the State Bank. The NMPAD is chaired by a deputy Prime Minister; its members include the Governor of the State Bank, the Minister of Finance, and other experts.

Every year, the State Bank prepares a report on the implementation of the previous year's monetary policy and the monetary outlook for the next year. The State Bank then submits a projection for the next year's monetary policy to the government for consideration and approval. After consulting with the NMPAD, the government submits the projection to the National Assembly for final approval.

Once the draft receives the National Assembly's approval, the State Bank of Vietnam will conduct the implementation of the monetary policy and report to the government and the National Assembly about the policy's progress, as well as any adjustments necessary to suit the development of the money market.

In reviewing the regulation process, it is obvious that the State Bank has little autonomy or control over monetary policy. The main responsibility for monetary policy is held by the National Assembly, which decides the annual rate of expected inflation, credit and money growth.

Tools of Monetary Policy

In conducting monetary policy, three tools are generally available in Vietnam. These are discount policy, open market operations, and setting reserve requirements. First, regarding discount policy, the State Bank has two lending facilities, a discount facility and a refinancing facility. Regarding the former, based on monetary targets including approved level of the money supply, the State Bank sets up the total volume of discount lending and then allocates each bank a quota, taking into consideration the bank's total assets, equity and outstanding credit. Discount operations can take the form of either an outright purchase of securities or a repurchase agreement. Eligible securities include treasury bills and bonds, State Bank bills and other securities approved by the Governor. Generally, securities must have a remaining maturity of less than 91 days and must be denominated in VND and transferable. The refinancing rate serves as the ceiling and the discount rate serves as the floor rate for lending from the State Bank. Recently, both the refinance and discount rates have been increased to tighten monetary policy. Since December 2005, the refinance and discount rates have been 6.5% and 4.5% per annum, respectively (SBV, 2005).

Second, as for open market operations, the State Bank started using this tool in July 2000, in which the State Bank trades securities with credit institutions. The total number of member institutions is 35, including the State Bank as the regulator. Eligible instruments include State Bank bills, central government bonds, bills and municipal bonds issued by the governments of Hanoi and Ho Chi Minh cities. The securities must satisfy the conditions (i) tradable; (ii) denominated in VND; (iii) kept under custody of the State Bank; and, (iv) have the remaining maturity less than 91 days (for outright sales and purchases) and longer than contracted maturity (for repos). Auctions take the forms of volume bid or interest rate bid, in which the interest rate is finalized and fluctuates between the refinance rate as the ceiling and the discount rate as the floor. Over the years, open market operations have become the most important instrument for controlling liquidity.

Finally, required reserves in various forms have been used since the 1990s and they were previously an important instrument of monetary policy. Reserve requirements are classified according to the maturity of deposits, the type of banks, and whether a deposit is denominated in domestic or foreign currency. During recent years, reserve requirements have been raised several times to tighten monetary policy. In June 2007, reserve requirements imposed on foreign currency deposits were increased to 4% for long-term and 10% for demand and short-term deposits, regardless of the type of banks. For VND short-term deposits, the ratios are (i) 10%, applied to state-owned commercial banks (excluding the Bank for Agriculture and Rural Development), urban joint stock banks, branches of foreign banks, joint venture banks, finance companies and leasing companies; (ii) 8%, applied to the Bank for Agriculture and Rural Development; and, (iii) 4%, applied to rural joint stock banks and the Central People's Credit Fund. For VND long-term deposits, the ratio is 4%, applied to all banks.

The VND prime interest rate and the nominal exchange rate between VND and USD are sometimes also referred to as monetary instruments in Vietnam. However, the prime

interest rate has rarely changed over time. It has been fixed at 8.25% per annum for several years. Also, the nominal exchange rate between VND and USD is allowed to fluctuate only within a narrow band. The State Bank also carries out interventions to keep the domestic currency depreciating against USD in an attempt to maintain export competitiveness. Therefore, despite being pronounced as monetary instruments, those variables are of little importance when studying Vietnam's monetary policy quantitatively.

4. Data and Methodology

To study the monetary transmission mechanism empirically in Vietnam, we use quarterly, seasonally-adjusted data from 1996Q2 to 2005Q4. The dataset included the following variables:

output: Real industrial output (constant 1994 price)
cpi: Consumer Price Index (CPI), (2000=100)
m2: Broad money, measured in billions of VND
irate: Real lending rate,which equals bank lending rate minus same period inflation
credit: Domestic credit, measured in billions of VND
reer: Index of the real effective exchange rate (1996=100)
oil: World oil price, in USD/barrel
rice: Rice price, in USD/ton
ffr: US federal Funds rate

These variables are taken from the International Monetary Fund's (IMF) International Financial Statistics (IFS), except for *output* (from the Vietnam General Statistics Office) and *reer* (CPI-based, calculated with data collected from IMF's IFS and Direction of Trade databases). We use industrial output as a proxy for GDP because quarterly data on GDP for Vietnam are only available since 2000. The summary statistics for these variables and their percent changes are presented in Table A2 in the Annex. Table 1 shows data for the first quarter of each year and table A1 in the Annex for all quarters.

Table 1. Data for the first quarter of the period 1996-2005

date	output	cpi	m2	irate	credit	reer	oil	rice	ffr
1996Q1	27417	87.14	48941		22628	102.28	18.31	364.63	5.36
1997Q1	31004	90.17	58538	13.69	28337	102.50	21.08	342.13	5.28
1998Q1	34970	93.92	72844	13.10	36465	107.42	14.16	295.17	5.52
1999Q1	41602	102.25	92042	11.82	41987	105.44	11.64	279.29	4.73
2000Q1	49497	100.48	158723	11.12	121275	99.25	26.62	239.77	5.68
2001Q1	55203	99.15	213454	11.84	165199	99.49	26.07	182.21	5.59
2002Q1	63727	101.76	253558	7.36	202751	99.51	20.92	191.59	1.73
2003Q1	75328	105.73	298614	8.82	247367	94.63	31.34	198.48	1.25
2004Q1	90662	110.37	401290	7.09	341984	91.17	32.13	220.35	1.00
2005Q1	103521	120.33	513412	9.32	464894	93.18	46.13	291.91	2.47

Note: See table A1 in the Annex for all quarters

The Augmented Dickey-Fuller tests in Table A3 in the Annex show that all the variables display evidence of nonstationarity. Therefore, we transform the variables into percent changes to eliminate nonstationarity. We reject nonstationarity at the 5% level for the percent changes, as also shown in Table A2, except for CPI in which nonstationarity can only be rejected at the 10% level. Different criteria suggest different optimal lag lengths for the VAR model, as shown in Table 2. We will use four lags in the basic and extended models, though we have found qualitatively similar results with various lag lengths.

Table 2. Lag Length Selection of the Basic and Extended Models

Lag	LogL	LR	FPE	AIC	SC	HQ
	Basic Model					
0	-235.1408	NA	273.6119	14.12233	14.65559*	14.30641
1	-223.269	18.99486	235.3314	13.95823	14.89144	14.28037*
2	-220.2227	4.351910	341.6829	14.29844	15.63160	14.75865
3	-204.8113	19.37432*	252.2316	13.93207	15.66518	14.53034
4	-192.2303	13.65935	228.8619*	13.72745*	15.86050	14.46378
	Interest Rate Channel					
0	-354.3412	NA	34120.33	21.78478	22.50307	22.02973
1	-307.9705	70.91996*	5899.927*	19.99826	21.43484*	20.48818*
2	-300.4601	9.719307	10646.77	20.49765	22.65252	21.23252
3	-280.0063	21.65698	9957.244	20.23566	23.10881	21.21549
4	-253.1115	22.14866	7609.178	19.59479*	23.18623	20.81958
	Exchange Rate Channel					
0	-324.8875	NA	3400.874	19.47928	20.19030*	19.72473*
1	-307.2128	27.26942*	3181.043*	19.38359	20.80562	19.87448
2	-299.5922	10.01570	5578.414	19.86241	21.99546	20.59874
3	-275.7927	25.83944	4262.548	19.41673	22.26079	20.39850
4	-249.5736	22.47353	3317.518	18.83278*	22.38786	20.05999
	Credit Channel					
0	-363.1502	NA	30279.63	21.66573	22.37674	21.91117
1	-344.8843	28.18170	27381.40	21.53625	22.95828	22.02713
2	-305.156	52.21437*	7666.302	20.18034	22.31339*	20.91667
3	-283.0527	23.99780	6454.164	19.83159	22.67565	20.81336
4	-260.385	19.42947	6153.449*	19.45057*	23.00565	20.67779*

Note: * Indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final Prediction Error; AIC: Akaike Information Criterion; SC: Schwarz Information Criterion; HQ: Hannan-Quinn Information Criterion.

Regarding methodology, we estimate a reduced form VAR model in order to analyze the Granger causality tests, variance decompositions, and impulse response functions for the effect of monetary shocks on output and inflation. After estimating a basic model, we

add additional variables to examine the effects of specific channels, namely the interest rate channel, the exchange rate channel, and the credit channel.

We estimate the basic VAR with the order of endogenous variables (*output, cpi, m2*) and a vector of exogenous variables (*oil, rice, ffr*). The ordering of the variables is based on the assumption that a shock to the money supply would be transmitted to the price level and output. The variables *oil, rice,* and *ffr* were included in the model as exogenous in order to control for external shocks, taking into consideration the openness of Vietnam's economy and the use of the USD/VND exchange rate as a nominal anchor in monetary policy.

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 (SBV, 2003). In choosing a quantity instead of price, 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, interest rates do not seem to be a suitable representative of the monetary policy stance in Vietnam.

5. Results

In this section, we analyze the monetary transmission mechanism in Vietnam. The analysis includes reference to Granger causality tests in Table 4, variance decompositions in Table A4, and impulse response functions in Figure 1.

Basic VAR Model

Monetary theory suggests that an increase in the money supply leads to an increase in the price level and a potential increase in real output. In the basic model, we look at the overall effect of money in the reduced form VAR without distinguishing between channels. The Granger causality tests show that money Granger causes output at the 5% significance level. However, in the basic model, neither money nor output Granger cause inflation. This is to some extent puzzling for monetary theory, but can be explained partly by the fact that industrial output is not a perfect proxy of GDP. Moreover, the price level, which is represented by the CPI, was also affected by other factors, such as prices of imported goods and fluctuations of the nominal exchange rate and not much affected by industrial output or the actual quantity of money.

The variance decomposition demonstrates that money shocks are a very important source of fluctuations in output, accounting for 44.24% shocks in output after four quarters, while own shocks account for 50.18% and inflation accounts for only 5.58%. For prices, own shocks account for most of the shocks—82.2%—while money accounts for only 0.64% and output accounts for 17.16%. This suggests that money can affect output but has little effect on price level.

We can find further confirmation and direction by looking at the impulse responses for the overall effect of money on real output and inflation. A positive shock to money leads to a positive response of output for the first and second quarters. As for inflation, initially, an expanding money supply reduces the price level, but by the third quarter the price level begins to increase consistently through the eighth quarter. This complies with what macroeconomists often refers to as "price stickiness."

Interest Rate Channel

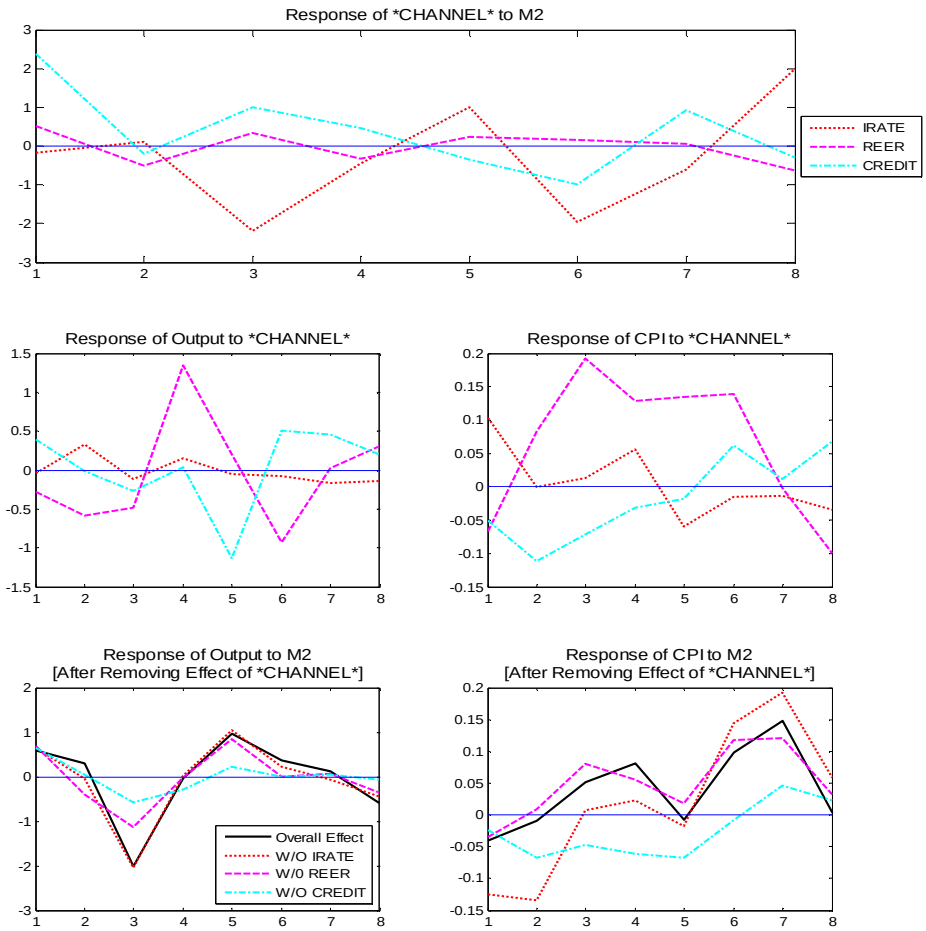
In order to analyze the effect of the traditional interest rate channel, we add the real lending rate (*irate*) to the basic model, which is equal to the bank lending rate minus inflation in the same period. This allows us to consider how money affects interest rates, how interest rates affect output and inflation, and how much change there is in the impact of money on output and inflation after controlling for the role of interest rates. Now, the VAR ordering is *output, cpi, irate,* and *m2* as endogenous variables and *oil, rice, and ffr* as a vector of exogenous variables. This ordering reflects the fact that a change in the money supply would affect the real interest rate, which would, in turn, affect investment. According to traditional Keynesian economics, an increase in real interest rate discourages investment and eventually leads to a decrease in output.

Interest rates were not liberalized in Vietnam until recently and do not fully reflect the demand for and supply of money in the money market. As such, we do not find evidence that the traditional interest rate channel plays an important role in transmitting monetary policy in Vietnam. First, the Granger causality tests show that when the real lending rate is added to the model, money still Granger causes output with 5% significance. However, money does not Granger cause the interest rate or price level. Moreover, the interest rate does not Granger cause money, output, or prices.

Table 3. Granger Causality Tests, p-values for the χ^2 Tests, VAR Analysis Using Data in Percent Changes

Dependent Var.	**Excluded Variable(s)**				
Basic Model	OUTPUT	CPI	---	M2	All
OUTPUT	---	0.2847	---	0.0001	0.0004
CPI	0.5927	---	---	0.9773	0.9190
M2	0.2795	0.1345	---	---	0.3077
Interest Rate Channel	OUTPUT	CPI	IRATE	M2	All
OUTPUT	---	0.4673	0.3592	0.0011	0.0013
CPI	0.2773	---	0.2082	0.8639	0.6631
IRATE	0.2436	0.3959	---	0.8594	0.3367
M2	0.3205	0.3967	0.5649	---	0.4971
Exchange Rate Channel	OUTPUT	CPI	REER	M2	All
OUTPUT	---	0.0342	0.0519	0.0000	0.0000
CPI	0.5896	---	0.8601	0.9582	0.9819
REER	0.7464	0.4665	---	0.8280	0.7408
M2	0.6066	0.1267	0.3755	---	0.3154
Credit Channel	OUTPUT	CPI	CREDIT	M2	All
OUTPUT	---	0.1222	0.4070	0.0005	0.0012
CPI	0.7641	---	0.9273	0.9885	0.9899
CREDIT	0.2589	0.1814	---	0.2831	0.0915
M2	0.3687	0.7730	0.0000	---	0.0000

Figure 1. Impulse Response Functions (Cholesky One S.D. Shocks)



Variance decomposition (see table A4 in the Annex) shows that in adding the real lending rate to the basic model, 48.06% of the shocks in output after four quarters were due to shocks in the money supply, which was higher than that in the basic model. Moreover, the real lending rate accounted for only 3 to 4% of the shocks to ouput, prices, and money, which suggests that the significance of the interest rate channel may be small. The impulse response functions provide further evidence. The top part of Figure 1 shows that a shock to the money supply will have a negative overall effect on the interest rate. But the second part of Figure 1 shows that real output has very little response to interest rates, while inflation does have a small initial increase, but eventually decreases after the first year. The bottom part of Figure 1 also shows that in the case of real output, a shock to money has almost the same impact on output whether or not we control for interest rate

movements, while money has a more negative impact on CPI when controlling for interest rates, at least during the first year.

Exchange Rate Channel

In order to analyze the effect of the exchange rate channel, we add the real effective exchange rate (*reer*) to the basic model. The ordering of the model is *output*, *cpi*, *reer*, and *m2* as endogenous and *oil*, *rice*, and *ffr* as exogenous, based on the assumption that an increasing money supply would lead to a depreciation of domestic currency, thus boosting net exports and aggregate demand. When interpreting the effects of this channel, it should be made clear that Vietnam maintained capital controls and a rigid exchange rate regime during much of this period. The Granger causality tests show that when adding the real effective exchange rate to the basic model, money supply still Granger causes output and now price level also Granger causes output. The real effective exchange rate also just misses Granger causing output with 5% significance. This helps to establish a link between the exchange rate and output. At the same time, none of the endogenous variables Granger cause the exchange rate.

Variance decomposition shows that both the real effective exchange rate and money supply were important sources of shocks in output. After eight quarters, money supply accounted for 21.25% of the shocks in output, whereas the real effective exchange rate accounted for 26.08% of the shocks. However, money accounted for only 5.57% of the shocks in the real effective exchange rate after four quarters while own shocks and shocks in the price level accounted for 51.5% and 41.22%, respectively. Output appeared to contribute little to the shocks in the real effective exchange rate, only 1.71% after four quarters. The impulse response functions show that a positive shock money has little effect on the real effective exchange rate, but that a positive shock to the real effective exchange rate (real appreciation) leads to a decrease in output for the first three quarters, before a turnaround in the fourth quarter. Including the exchange rate channel helps to temper the fluctuations in the response of output to money.

Credit Channel

As suggested by Mishkin (1995), the credit channel operates through two main components—the balance sheet channel and the bank lending channel. Theory suggests that increasing money supply increases the total credit that banks can supply to the economy and, through the bank lending channel, will in turn boost aggregate demand and output. In analyzing the balance sheet channel, Bernanke and Gertler (1995) focused on the external finance premium, which they defined as the wedge between the cost of funds raised externally and the opportunity cost of internal funds. However, in Vietnam this channel may be insignificant because, until recently, most credits were given to large, state-owned enterprises according to government directives without consideration of their financial positions. To analyze the credit channel, we add the domestic credit variable to the basic VAR model. The ordering of the VAR is *output*, *cpi*, *credit*, and *m2*, based on the assumption that an increase in the money supply will lead to an increase in credit and eventually to an increase in aggregate demand and output. The VAR model also contains the same vector of exogenous variables.

The Granger causality test indicates that money supply still Granger causes output at 5% significance level. However, credit does not Granger cause output or price level. Credit does Granger cause the money supply with high significance though. This reflected the fact that the State Bank used mainly credit as a channel to inject liquidity into the market. Variance decomposition shows that, after eight quarters, credit accounted for 23.08% of

the shocks in output, while money supply accounted for only 9.51% of the shocks in output after eight quarters. Credit also accounted for 38.31% of the shocks in money supply after eight quarters. With the impulse response functions, we see that a shock to money does lead to an initial increase in credit growth, though it quickly dissipates. Meanwhile, there is no clear trend between output and credit, though in the bottom part of Figure 1 we find that after controlling for the credit channel, the relationship between money and output has been substantially weakened.

6. Conclusion

Our analysis has found a strong link between the money supply and the real output, though we do not find a strong connection between the money supply and inflation. Also, we find that the interest rate channel plays little role in transmitting monetary policy for Vietnam. Instead, the exchange rate channels and credit play a stronger role. Studying the monetary transmission mechanism for Vietnam is important because it is a country receiving large capitals inflows and is also accumulating foreign reserves, which pushes addition liquidity into the banking system. In subsequent research, we hope to understand more about what causes inflation in Vietnam, and we will also investigate the role of asset price channels as the financial sector of Vietnam continues to develop.

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Annex on line at the journal Website: http://www.usc.es/economet/aeid.htm

Appendix

Table A1. Data

DATE	OUTPUT	CPI	M2	IRATE	CREDIT	REER	OIL	RICE	FFR
1996Q1	27417	87.14	48941		22628	102.28	18.31	364.63	5.36
1996Q2	28399	88.43	50619	19.52	22689	101.30	19.49	333.18	5.24
1996Q3	29961	88.23	53525	19.72	25981	99.63	20.63	340.63	5.31
1996Q4	30947	89.29	56066	17.70	27661	101.20	23.06	313.81	5.28
1997Q1	31004	90.17	58538	13.69	28337	102.50	21.08	342.13	5.28
1997Q2	31903	90.09	62936	15.08	30646	98.67	18.49	315.68	5.52
1997Q3	33139	91.45	66700	12.99	32283	104.36	18.66	291.73	5.53
1997Q4	35258	92.72	69809	12.12	34700	112.58	18.84	260.33	5.51
1998Q1	34970	93.92	72844	13.10	36465	107.42	14.16	295.17	5.52
1998Q2	35353	97.10	77426	11.01	36431	113.49	13.28	320.17	5.50
1998Q3	37153	99.06	82283	12.38	36872	105.53	13.00	322.67	5.53
1998Q4	40081	100.86	86410	12.59	40506	100.73	11.85	283.69	4.86
1999Q1	41602	102.25	92042	11.82	41987	105.44	11.64	279.29	4.73
1999Q2	43734	102.11	100533	13.34	83478	103.77	16.03	244.83	4.75
1999Q3	45845	101.78	108048	12.72	83383	99.49	20.44	246.58	5.09
1999Q4	47135	100.80	144054	12.97	112915	97.55	23.81	225.17	5.31
2000Q1	49497	100.48	158723	11.12	121275	99.25	26.62	239.77	5.68
2000Q2	52235	99.73	170328	11.54	130928	98.04	26.77	204.55	6.27
2000Q3	48093	99.44	181777	10.69	136670	97.32	29.88	185.41	6.52
2000Q4	49638	100.34	195353	9.29	151950	97.49	29.67	185.05	6.47
2001Q1	55203	99.15	213454	11.84	165199	99.49	26.07	182.21	5.59
2001Q2	58296	98.88	228276	9.62	168179	98.32	26.73	164.71	4.33
2001Q3	61236	99.65	238895	8.22	178267	101.14	25.21	170.49	3.50
2001Q4	57824	100.59	248660	7.74	188131	97.65	19.31	173.42	2.13
2002Q1	63727	101.76	253558	7.36	202751	99.51	20.92	191.59	1.73
2002Q2	65432	102.81	264499	7.71	211460	95.53	25.20	196.60	1.75
2002Q3	68672	103.87	274004	8.47	226175	94.33	26.94	193.14	1.74
2002Q4	72724	105.10	281374	8.30	237592	94.47	26.74	185.98	1.44
2003Q1	75328	105.73	298614	8.82	247367	94.63	31.34	198.48	1.25
2003Q2	78923	106.26	324971	8.94	274146	92.47	26.49	198.86	1.25
2003Q3	81115	106.66	347353	9.17	292022	90.49	28.38	199.59	1.02
2003Q4	84035	107.73	373189	8.51	316616	88.17	29.36	200.92	1.00
2004Q1	90662	110.37	401290	7.09	341984	91.17	32.13	220.35	1.00
2004Q2	96559	113.79	421721	6.44	370608	93.56	35.63	249.74	1.01

2004Q3	101145	116.98	453788	6.87	393297	93.74	40.55	248.29	1.44
2004Q4	104889	118.56	487576	8.33	416324	90.80	42.73	264.76	1.95
2005Q1	103521	120.33	513412	9.32	464894	93.18	46.13	291.91	2.47
2005Q2	109345	122.87	547383	8.76	493916	96.19	50.78	293.82	2.94
2005Q3	116009	125.77	589148	8.72	537749	96.27	59.96	283.20	3.46
2005Q4	120663	128.66	636763	9.03	584006	99.54	56.55	282.31	3.97

Sources: See "Data Description" within paper

Table A2. Summary Statistics

	Data in Levels, 1996Q2 to 2005Q4 (39 obs.)			**Data in Percent Changes, 1996Q3 to 2005Q4 (38 obs.)**		
Variable	**Mean**	**Median**	**Std. Dev.**	**Mean**	**Median**	**Std. Dev.**
OUTPUT	61827	55203	27232	3.81	4.65	3.52
CPI	103.17	100.86	10.21	0.99	1.03	1.11
M2	238101	213454	168143	6.66	6.36	4.06
REER	98.63	98.32	5.57	-0.05	0.12	3.32
IRATE	10.84	9.62	3.25	-2.03	-1.29	11.35
CREDIT	192970	165199	159939	8.55	6.52	11.15
OIL	27.04	26.07	11.60	2.80	4.31	12.70
RICE	246.67	246.58	54.69	-0.44	0.28	7.56
FFR	3.82	4.73	1.91	-0.73	0.21	15.64

Table A3. Augmented Dickey-Fuller Tests

	Data in Levels, 1996Q2 to 2005Q4 (39 obs.)			**Data in Percent Changes, 1996Q3 to 2005Q4 (38 obs.)**		
Variable	**# Lags**	**t-statistic**	**p-value**	**# Lags**	**t-statistic**	**p-value**
OUTPUT	0	3.33	1.000	0	-6.90	0.000
CPI	1	1.19	0.998	0	-2.67	0.088
M2	0	9.92	1.000	0	-4.72	0.001
IRATE	0	-2.88	0.057	0	-6.73	0.000
REER	0	-1.99	0.292	0	-7.31	0.000
CREDIT	0	7.66	1.000	0	-7.40	0.000

Note: All of these tests include only a constant term as an exogenous variable

Table A4. Variance Decomposition (Order reflects Cholesky Ordering) VAR Analysis Using Data in Percent Changes

Variable	**Period**	**Decomposition**				
Basic Model		S.E.	OUTPUT	CPI		M2
OUTPUT	4	4.25	50.18	5.58		44.24
	8	4.88	45.09	13.61		41.30
CPI	4	1.25	17.16	82.20		0.64
	8	1.31	17.70	77.37		4.93
M2	4	5.14	16.51	19.12		64.37
	8	5.42	19.94	18.75		61.31
Interest Rate Channel		S.E.	OUTPUT	CPI	IRATE	M2
OUTPUT	4	4.49	44.10	4.21	3.63	48.06
	8	5.31	36.93	12.87	3.88	46.32
CPI	4	1.33	31.60	61.72	3.47	3.22
	8	1.44	32.21	53.94	3.89	9.97
IRATE	4	11.89	3.98	69.20	18.49	8.32
	8	14.00	9.98	61.73	15.82	12.46
M2	4	5.76	17.04	15.41	3.58	63.97
	8	6.36	21.62	14.67	4.06	59.65
Exchange Rate Channel		S.E.	OUTPUT	CPI	REER	M2
OUTPUT	4	4.00	47.13	16.09	8.75	28.03
	8	5.32	31.47	21.20	26.08	21.25
CPI	4	1.44	15.19	78.12	5.67	1.02
	8	1.53	16.15	69.36	10.27	4.22
REER	4	4.88	1.71	41.22	51.50	5.57
	8	5.21	4.93	40.17	48.62	6.28
M2	4	5.31	24.50	16.09	20.23	39.19
	8	5.90	22.59	16.16	27.85	33.40
Credit Channel		S.E.	OUTPUT	CPI	CREDIT	M2
OUTPUT	4	3.72	65.98	17.03	3.81	13.17
	8	4.93	43.56	23.85	23.09	9.51
CPI	4	1.33	13.81	81.98	2.66	1.55
	8	1.38	15.86	77.37	3.40	3.37
CREDIT	4	12.54	4.13	26.32	63.48	6.08
	8	16.20	5.50	38.17	51.41	4.93
M2	4	4.00	5.98	13.40	57.14	23.49
	8	5.10	12.41	32.01	38.31	17.27