Draft for Comments

# Demand for Money in Dollarized, Transitional Economy: The Case of Vietnam

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## Abstract

The negative correlation between broad money and inflation emerged after the outburst of Asian financial crisis. It poses a puzzle if it is interpreted within a widely accepted macroeconomic framework in which the growth of money supply and inflation positively correlate. This paper solves the puzzle by decomposing the demand for money into the demand for domestic currency and the demand for foreign currency in view of the fact that Vietnam is highly dollarized. The empirical analysis employs cointegration, error correction model, impulse response and variance decomposition and uses quarterly data over the period 1993-2004. The results show that the long run demand for real broad money of domestic currency is determined by real income, domestic interest rate, inflation rate and rate of return of USD deposits, which satisfies the standard properties of the demand for money. The long run demand for real foreign currency deposits is determined by real income and the difference between rates of returns of foreign and domestic currency deposits, that represents asset substitution. Demand for real foreign currency deposits is found to be very sensitive to the difference between rates of returns of foreign and domestic currency deposits, especially exchange rate depreciation. A positive difference between rates of returns of foreign and domestic currency deposits triggers a shift from domestic financial assets and real assets to foreign financial assets, resulting in a lower inflation rate and a strong increase in demand for foreign money. When this effect is very strong, then even an increase in broad money, including foreign currency deposits, may negatively correlate with inflation.

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# I. INTRODUCTION

Table 1 shows that in Vietnam, during the period of 1993-2004, growth rate of broad money (M2) positively correlated with inflation (INF_A). However, after the outburst of Asian financial crises, the correlation was negative, contradicting a widely accepted macroeconomic framework in which the growth rate of money supply should positively correlate with inflation. These facts are also illustrated in Figure 1 and 2. Why the growth rate of broad money negatively correlated with inflation?

**Table 1: Simple Correlation between Annual Changes in Broad Money (M2), Broad Money of VND (M2VND), Foreign Currency Deposit (FCD), Output (GDP) with Domestic Interest rate (DEPO), Inflation (INF): Quarterly data**

| | M2 | M2VND | FCD | INF_A | GDP |
|---|---|---|---|---|---|
| *During 1993:1-2004:4* | | | | | |
| INF_A | 0.6099 | 0.6931 | -0.3217 | 1 | |
| GDP | 0.5362 | 0.5871 | -0.2104 | 0.4839 | 1 |
| DEPO | 0.6878 | 0.7729 | -0.1703 | 0.7117 | 0.5510 |
| *During 1997:3-2004:4* | | | | | |
| INF_A | -0.4388 | 0.1561 | -0.4380 | 1 | |
| GDP | -0.4628 | -0.2296 | -0.1462 | 0.0632 | 1 |
| DEPO | 0.0342 | -0.2080 | 0.2269 | 0.6132 | -0.1892 |
| *During 2000:1-2004:4* | | | | | |
| INF_A | -0.6881 | 0.4458 | -0.7939 | 1 | |
| GDP | -0.5631 | -0.0814 | -0.3317 | 0.5347 | 1 |
| DEPO | -0.8445 | 0.0835 | -0.6413 | 0.7447 | 0.7078 |

**Figure 1: Annual Changes in Price, Broad Money, Broad Money of Vietnam Dong and Foreign Currency Deposits (1993:1-2004:4)**

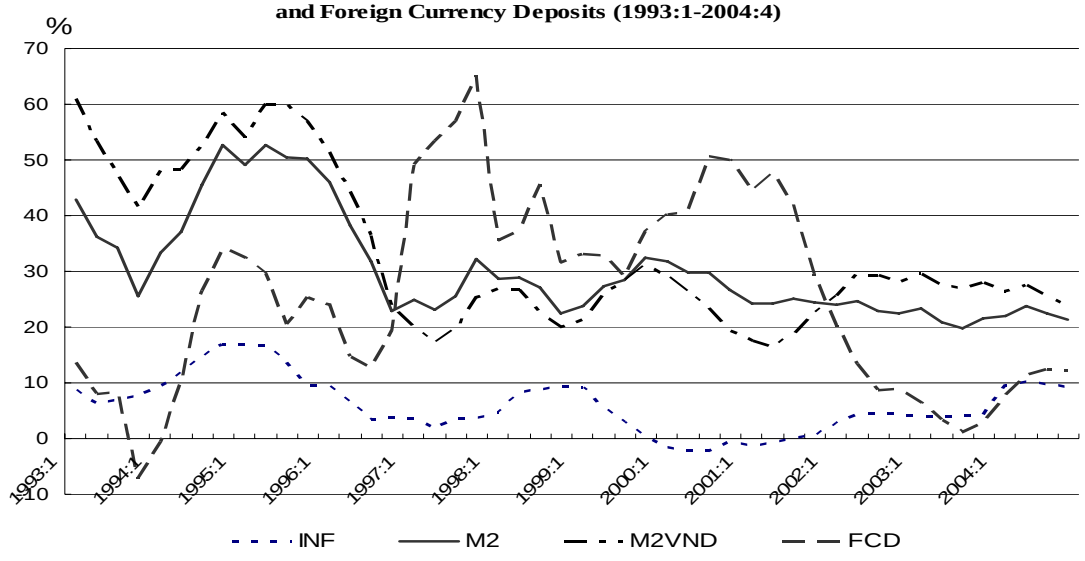


**Figure 2: Annual Changes in Price, Broad Money, Broad Money of Vietnam Dong and Foreign Currency Deposits (1997:3-2004:4)**

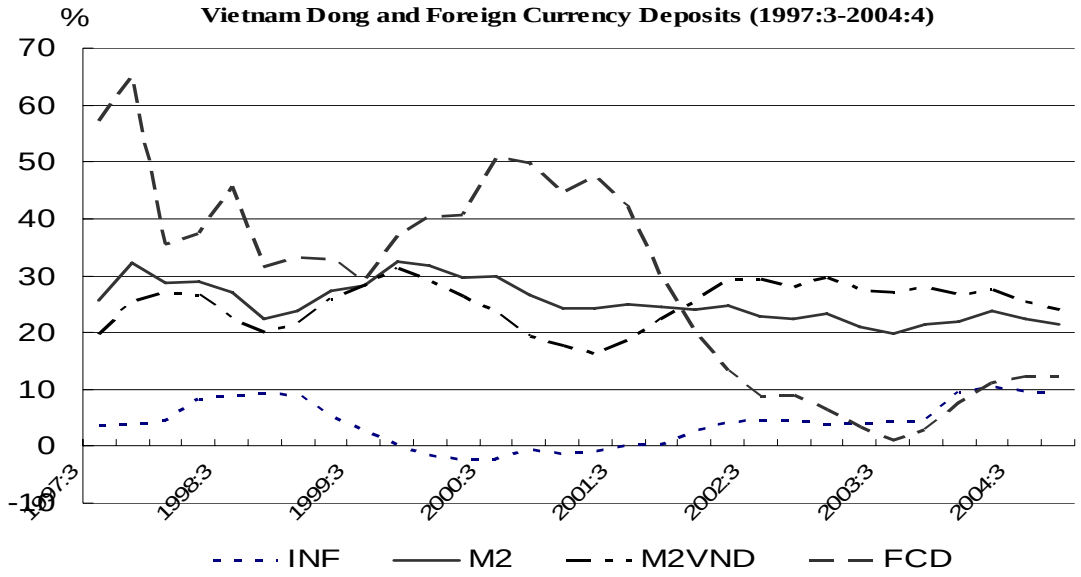



Table 1 and Figure 1 & 2 also indicate that the puzzle of negative correlation between growth rate of broad money and inflation was caused by the negative correlation between growth rate of foreign currency deposit (FCD) and inflation since growth rate of broad money of domestic currency (M2VND) has positive correlation with inflation. In view of the fact that Vietnam is highly dollarized,[2] the above observations indicate that, in order to solve the puzzle, we should look at broad money components: broad money of domestic currency and foreign currency deposits, instead of looking at broad money as a whole.

Vietnam is a transitional economy. Since 1986, the economy started shifting from a centrally-planned towards a market one with high growth rate. However, the financial system is not liberated quickly enough to conform to the economic growth. The banking system has been playing a key role in funding the economy. Interest rate was fixed by central bank and has just liberated since June 2002. However, the monetary policy still lack money demand model, thus constraining monetary policy's effectiveness in controlling inflation.[3]

[2] The foreign currency deposit (FCD)/M2 ratio in Vietnam is as follows (%):

| 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.9 | 22.9 | 19.3 | 16.8 | 20.8 | 22.5 | 23.4 | 26.3 | 29.7 | 27.1 | 23.5 | 21.9 |

[3] A general understanding is that understanding about money demand is a key tool so that central bank can use money supply to control inflation.

Only a few empirical researches about money demand in dollarized economies have been conducted. Very few works has tried to find money demand model in Vietnam and none has generated the money demand model by taking fully into account the dollarization situation in financial system in Vietnam.

This paper aims to estimate the money demand function of Vietnam and studies the characteristics of the economy. In order to solve the puzzle of negative correlation between growth rate of broad money and inflation, it develops and estimates the money demand model in Vietnam by formulating demand for real broad money of domestic currency and demand for real foreign currency deposit and conducts some analyses to research empirically the economy. Particularly, it answers the following questions:

i) What are the characteristics of broad money of domestic currency and foreign currency deposits? Since this is an open developing country having high degree of dollarization, asset substitutions is considered in the models.

ii) What are the characteristics of the economy when there is a shock in rate of return of foreign currency deposit, the characteristics of real broad money of domestic currency when there are shocks of interest rate, inflation, output and foreign rate of return, and the characteristics of real foreign currency deposit when there are shocks of output and the difference between rates of returns of foreign and domestic deposits?

iii) What are the characteristics of domestic currency, output, inflation, domestic interest rate and foreign rate of return?

This paper investigates the demand for broad money of using quarterly data from 1993:1-2004:4. In accomplishing its task, the paper employs cointegration, error correction model, impulse response and variance decomposition.

The paper is organized as follows: Section 2 describes the theoretical and empirical researches about demand for money; Section 3 presents the demand for money model and the analysis of empirical results. The last is a short conclusion.

## II. THEORETICAL AND EMPIRICAL FRAMEWORK

Many economists have tried to theorize the money demand. The notables are Fisher (1911), Pigou (1917), Keynes (1930 and 1936), Baumol (1952), Samuelson (1958), Tobin (1958), Friedmand (1956 and 1970) and McCallum (1989). Keynes (1930 and 1936) developed money demand theory based on motives leading people to hold money: transaction, precaution and speculation motives. Tobin (1958) and Friedmand (1970) made a significant advancement in money demand theory by considering money as a part among a portfolio of assets including money with other financial and real assets. Thus, the standard money demand equation has the formulation as $M^d/P = f(Y/P, OC)$, where $M^d/P$ is real money demand, Y/P is the real transactions and OC is a vector of opportunity costs.

Regarding the money demand model in dollarized economies, since foreign money is used popularly as an asset besides domestic money in agents' portfolio, Branson and Henderson (1985) shows that it is necessary to separate broad money into domestic and foreign money. Each of them is determined by income and their relative returns:

$$m = f(\overset{+}{y}, \overset{+}{i}, \overset{-}{i^*}, \Delta \overset{-}{e})$$

$$m^* = f(\overset{+}{y}, \overset{-}{i}, \overset{+}{i^*}, \Delta \overset{+}{e})$$

where m and m* are the real domestic and foreign broad money, *i* and *i** are domestic and foreign interest rate, respectively; *y* is real income; and $\triangle$e is depreciation rate.

### 2.1 General Empirical Research about Money Demand

There are a large stream of empirical researches have been dedicated to demand for money, especially in developed countries (Hafer and Dennis 1991, Kole and Ellen 1995, Laurence 1998). The attention in developing country's cases has been rising in recent years driven by increasing role of these countries in the world economy and financial market and efforts to improve economic management in these countries (Bossogo 2000, Dekle and Pradhan 1997, Ibrahim 1999, Robert and Mahmood 1997).

One important factor fuelling the empirical researches on money demand is big advancements in time series analysis in the past decade.

Sriram (1999a) has shown that, in order to get meaningful results, the two most important points in modeling demand for money are: first, selection and representation of variables and second, framework of model. Regarding the variable selection, the monetary aggregates can be denoted by M0, M1, M2, M3 or broader monetary aggregates or components of theirs; while economic transactions can be represented by Gross Domestic Product (GDP), Gross National Product (GNP) or Industrial Index (Laidler, 1993; Laurence, 1998; and McCallum, 1989).

Ericsson (1998) and Nachega (2001) have proved that the choice of opportunity cost variables turns out to be the most important factor in getting meaningful results. The opportunity cost of holding money comprises own rate of money and rate of return on substituted assets to money, including domestic and foreign financial assets and real assets. Regarding the own rate of money, when M0, M1 is dependent variable, the own rate of money can be considered as zero and when broad money (M2, M3, etc.) is dependent variable, the own rate should be short term deposit interest rate. The return on domestic financial assets is usually represented by yields on government bonds, bills, commercial papers or saving deposits. The return on real assets may have a proxy like inflation or, in narrower term, changes in prices of some popular assets in the economy. The return on foreign financial assets is usually represented by interest rates of foreign bill, foreign currency deposit, or expected rate of depreciation of domestic currency.

For the framework of the model, cointegration is employed popularly to capture the long run equilibrium and error-correction model is used to reflect the short run dynamic of money demand; both cointegration and error correction model proved to be useful tools in money demand research (Bossogo, 2000; Bank of England, 1999).

## 2.2 Empirical Research about Money Demand in Dollarized Economy

*Concepts of Dollarization, Currency Substitution and Asset Substitution*

Dollarization is denoted as a situation where one or some foreign currencies serves one or more functions of domestic currency- that includes medium of exchange, accounting and store of value (Watanabe, 2002). Currency substitution is the situation

where foreign currency is used only as means of payment (Sa and Zamaroczy, 2003). When foreign currencies served as stores of value, it is regarded as asset substitution (Berg and Borensztein, 2000). While currency substitution usually occurs from high inflation stimulating people to shift to foreign currency to safeguard value, asset substitution is arisen from risks and considerations between rates of returns of domestic and foreign assets (Oomes and Ohnsorge, 2004 and Pozo *et all* , 2000).

*Empirical Research about Money Demand in Dollarized Economies*

Previous empirical research shows that in general there are two ways in modeling the money demand in dollarized economies. The first is applied in low dollarization economies like China and Czech. In these countries, Huang (1994), Hafer and Kutan (1994), Tseng *et all* (1994) and Kot (2004) have formulated the money demand model with money balance as a function of income, domestic interest rate and inflation. There, the money balance can be the broad money as a total of both domestic and foreign currency.

The second formulation is used in economies with high degree of dollarization. The model formulation in these countries is followed Branson and Henderson (1985) and Porqueras *et all* (1999), which separates broad money into domestic and foreign money and estimates the money demand for each of them. The following presents more details about the empirical research of money demand in highly dollarized economies.

Rodriguez and Turner (2003) investigated the money demand in Mexico. By using cointegration technique, they found the following formulation of money demand:

$$\ln(\frac{M}{P})_t = \alpha_o + \alpha_1 \ln Y_1 + \alpha_2 \ln i_t + \alpha_3 i_t^f + \alpha_4 \Delta e_t^e + \alpha_5 \pi_t^d + \alpha_6 \ln(\frac{M}{P})_{t-1} + u_t \quad . (1)$$

where M/P is the real domestic money, Y is the scale variable (income), *i* is the interest rate on domestic bonds, $i^f$ is the interest rate on foreign bonds, $\triangle e^e$ is the expected rate of depreciation, $\pi^d$ is the difference between the inflation rates of the domestic and foreign economies.

For the money demand of foreign currency deposits, they first tried to formulate the model as (1) with nominal domestic money (M) is replaced by nominal foreign money, in terms of domestic currency (eM*). Their test got a result but signs of

some coefficients contradict with expectations. After some arrangements, they got the final and reasonable result by the following formulation:

$$\ln(\frac{eM^*}{M})_t = \alpha_o + \alpha_1 \ln Y_1 + \alpha_2(i_t - \pi_t) + \alpha_3(i_t^f - \pi_t^f) + \alpha_4 \Delta e_t^e + \alpha_5 \ln(\frac{eM^*}{M})_{t-1} + u_t \quad \ldots.(2)$$

The result shows that currency substitution evidences significantly in broad money equation, and exchange rate has important effects on demand for foreign money.

Analyzing the high dollarization problem in Latin America, Porqueras *et all* (1999) found that the development of financial markets and the increasing of the openness have further diversified and increased the available assets, especially the foreign financial assets, thus affecting the agent's portfolio basket. They set up the following model:

$$\log(\frac{R_{it}}{1-R_{it}}) = \log(\frac{m_{it}^f}{m_{it}^d}) = \gamma_0 + \gamma_1 \log(y_{it}) + \lambda_2 I_{it}^d + \lambda_3 E_{it} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (3)$$

The notation R as the ratio of foreign money over broad money: $R=m^f/(m^f+m^d)$, $m_t^d$ and $m_t^f$ represented the real broad money demand in domestic and foreign currency. While $I_t^d$ is interest rate of domestic deposits; $y_t$ is real national output, $E_{it}$ is the exchange rate depreciation and t denotes the time.

Using yearly data from 1990-1998, they used panel data to conduct the research by using equation (3) for 13 countries in Latin America (Argentina, Belize, Costa Rica, Dominica, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Paraguay, Peru and Uruguay). The result shows that income and exchange rate depreciation strongly affect the ratio of foreign currency deposits over broad money.

Bas and Nina (1995) investigated the money demand in six transitional economies in Eastern Europe (Bulgaria, Poland, Hungary, Romania, Czecho Slovakia, Czech Republic) during around 1986-1994 since in this period, these economies were reformed very quickly. This was accompanied by high degree of monetary instability, huge shocks in price levels and sharp increase in dollarization.

Following Cagan (1956), when the economy is in hyperinflations, the real money demand is mainly affected by inflation expectations. Thus, real output and real interest rate can be assumed to be constant and the domestic money demand and the demand for foreign money ($M_t^*$) can be written as:

$$\ln(m_t) = c + \delta D_t - \beta\pi^e - \gamma E^e + \eta D_t E^e + \varepsilon_t \quad \text{..... (4)}$$

$$\ln(\frac{e_t M_t^*}{P_t}) = \ln m_t^* = d + \chi D_t - \alpha\pi^{*e} + \delta E^e + \phi D_t E^e + \varepsilon_t \quad \text{..... (5)}$$

where $m_t$ is demand for domestic real money currency, $m_t^*$ is real foreign money demand measured by domestic currency, $\pi^{*e}$ is the foreign expected inflation and $\pi^e$ is the expected rate of inflation and $E^e$ is the expected rate of depreciation. $D_t$ is the dummy variable representing the financial liberalization in transitional economies during 1990s.

Using cointegration and error correction model techniques, they conducted the tests by using currency in circulation, base money, narrow money and foreign currency deposits as money aggregates. The result indicated that in each country with different monetary aggregates, the long run money demand was found. For example, in Bulgaria, Hungary inflation had a really strong and significant effect on both currency in circulation and narrow money, while the exchange rate affected significantly foreign currency deposits. In Poland, both inflation and exchange rate depreciation had significant effect on narrow money. In Romania, inflation and exchange rate depreciation had significant effects on currency in circulation while exchange rate depreciation had significant effect on narrow money and foreign currency deposits.

Considering that Vietnam is a dollarized economy, this paper investigates the money demand in Vietnam by using the model of Branson and Henderson (1985) and Porqueras *et all* (1999). Particularly, it separates the broad money into broad money of domestic currency and foreign currency deposits and estimate the money demand for each of these monetary aggregates. The explaining variables will be carefully chosen based on the analysis of financial operations in Vietnam.

## III. MODELS AND ANALYSES OF RESULTS

### 3.1 Models and Data

#### *3.1.1 Choice of Variables:*

**Real Money Stock ($RM2D_t$ and $RFCD_t$):**

Many recent money demand researches have used broad money instead of narrow money since broad money is considered to be better explained by economic variables than narrow money. Regarding the broad money (M2) in Vietnam, this includes currency in circulation, Vietnam Dong (VND) deposits and foreign currency deposits (primarily in USD), in which USD accounts for around 23.5% of M2 in average during 1993-2004. Following Porqueras *et all* (1999), this paper estimates money demand by estimating the demand for M2 of domestic currency (M2VND) and demand for foreign currency deposits (FCD). Hence, this paper employs real M2 of domestic currency and real foreign currency deposits as proxies for money stocks.

$$RM2D_t = Ln(\frac{M2ofVND_t}{CPI_t} * 100)$$

$$RFCD_t = Ln(\frac{FCD_t}{CPI_t} * 100)$$

where $M2ofVND_t$ is the nominal broad money balance of domestic currency and measured in billion VND, $FCD_t$ is the nominal foreign currency deposits balance in terms of domestic currency and also measured in billion VND (using exchange rate at the end of periods). $CPI_t$ is the consumer price index (1990=100) and t denotes time index.

**Real Gross Domestic Product ($RGDP_t$)**

The scale variable is used as a measurement of transactions reflecting the affects of economic activities on money demand. This paper employs gross domestic product as the scale variable since this is the only available data.

$$RGDP_t = Ln(\frac{NGDP_t}{GDPdeflator_t} * 100)$$

where $NGDP_t$ is the Nominal Gross Domestic Product (billion VND). GDP deflator has the year of 1994 as the base year (1994=100) .

**Interest Rate on 6 Month Domestic Currency Deposit ($DEPO_t$), Rate of return of USD (RF) and Annualized Inflation Rate ( $INF\_A_t$ )**

In the model of demand for real broad money of domestic currency, the selected opportunity costs of holding money are:

(i) the own-rate of money is represented by 6 month deposit nominal interest rate ($DEPO_t$). The 6 month VND deposit interest rates is chosen as a proxy since this is the most popular term of deposits in the economy.

(ii) the rate of return on financial asset alternative to money. Bonds and stocks are not popular in Vietnam; however USD is a very popular financial asset substitute to VND, so USD is chosen to be the financial asset alternative to money in model of domestic currency. Rate of return of alternative financial asset is represented by the expected rate of return of foreign currency deposit and the actual rate of return of short term USD deposit (RF) in terms of domestic currency is taken as the representative and calculated as follows:

$$RF_t = DEPOF_t + E_t^f$$

where $DEPOF_t$ is the 6 month USD deposit interest rate and $E_t^f$ is the expected depreciation rate, both of which are annualized. Like VND interest rate, the 6 month USD deposit interest rates is chosen as a proxy since this is the most popular term of deposits in the economy.

(iii) the rate of return on real assets alternative to money, following Nachega (2001), it is represented by inflation rate. The annualized inflation rate ( $INF\_A_t$) is computed by: $INF\_A_t = (\ln CPI_t - \ln CPI_{t-1})*4$.

**The Difference between Rate of Return of Foreign Currency Deposit and Yield of Domestic Currency Deposit ($DIFFER_t$)**

The difference between rates of returns of deposits by USD and VND ($DIFFER_t$) is calculated as rate of return of 6 month USD deposits in terms of domestic currency minus nominal interest rate of 6 month VND deposits. All data are annualized.

$$DIFFER_t = RF_t - DEPO_t = DEPOF_t + E_t^f - DEPO_t$$

In the model of demand for foreign money, DIFFER stands for speculation motive. When the difference between rate of return of USD (RF) and rate of return of domestic currency (DEPO) is positive, people are expected to shift from domestic currency deposit's holdings to USD deposits' holdings and, conversely, when the difference is negative, USD deposits are expected to be shifted to domestic currency deposits.

### *3.1.2 Model Specification and Data*

As explained in Section II, in a highly dollarized economy, the money demand can be formulated by estimating demand for domestic currency and demand for foreign currency. The money demand models can be written as follows:

$$RM2D_t = \beta_0 + \beta_1 RGDP_t + \beta_2 DEPO_t + \beta_3 INF\_A_t + \beta_4 RF_t + \varepsilon_t \quad \ldots\ldots (6)$$

$$RFCD_t = \alpha_0 + \alpha_1 RGDP_t + \alpha_2 DEPO_t + \alpha_3 INF\_A_t + \alpha_4 RF_t + \varepsilon_t \quad \ldots\ldots\ldots (7)$$

where $RM2D_t$ is real M2 of local currency, $RFCD_t$ is real foreign currency deposits in terms of domestic currency, respectively; $RGDP_t$ is real GDP; $DEPO_t$ is 6 month annualized domestic deposit interest rate; and $INF\_A_t$ is the actual annual domestic inflation rate. $RF_t = DEPOF_t + E_t^f$ is the rate of return of USD deposit in terms of domestic currency.

We may drop the inflation variable in the RFCD equation since foreign money serves as inflation hedge so inflation does not cause a shift from real asset to foreign money or conversely. Inflation may lead to a shift from domestic money to foreign money, however this effect is reflected in the effect of exchange rate (in RF) on foreign money (RFCD) as inflation is partly absorbed by exchange rate. During 1993-2004, the inflation is generally considered as in a low-medium level as the mean of annual inflation was 5.74%, taking into consideration that Vietnam is a transitional developing economy. Therefore, we may drop the inflation variable in the equation of RFCD.

The research has tried many various arrangements. At the end, the following formulation is accepted:

$$RFCD_t = \gamma_0 + \gamma_1 RGDP_t + \gamma_2 DIFFER_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (8)$$

where $DIFFER_t = DEPOF_t + E_t^f - DEPO_t$ is the difference between rates of returns of foreign and domestic currency deposits. It represents the asset substitution by domestic agents between domestic money and foreign money depending on rates of returns of these two currencies in terms of domestic currency.

*Expected Signs of Coefficients in the Domestic Money Demand Model*

The scale variable ($RGDP_t$) represents the transaction effect. It is positively related to money demand. Domestic interest rate is expected to have positive sign since the higher the own rate of return on money the more incentive to hold money. The inflation variable ($INF\_A_t$) is expected to have negative sign since agents prefer to buy real assets as inflation hedge in the periods of high inflation. The coefficient of the rate of return of foreign financial asset ( $RF_t$ ) is expected to be negative since the higher the rate of return of USD deposit, the more people wants to transfer from VND to USD and conversely. In summary, followed the model formulation as indicated in equation (6), the expected signs of variable coefficients can be written as follows: $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 < 0$.

*Expected Signs of Coefficients in the Foreign Money Demand Model,*

The scale variable (RGDP) represents the wealth effect and is expected to be positively related to the real money demand. The coefficient of DIFFER is expected to be positive since when rate of return of USD deposit is higher than yield of domestic currency deposit, people are expected to shift from domestic currency deposits to USD deposits and conversely. In summary, following the model formulation as indicated in equation (8), the expected signs of coefficients can be written as follows: $\gamma_1 > 0$, $\gamma_2 > 0$.

*Data*

The study uses quarterly data during 1993:1 - 2004:4. The reason to choose this period is that: (i) data are available only from 1991; (ii) inflation is exceptionally high during 1991 and 1992 in compared with later years. The data source for monetary, interest rate, inflation, exchange rate and GDP are from International Financial Statistic (IFS) and various issues of Vietnam Economic Review.

### 3.2 Unit Root Tests

Dickey and Fuller (1979) shows that if the characteristics of a stochastic process change over time, the stochastic process is non-stationary and if we use ordinary least square (OLS) to represent the relationship between non-stationary data series, we may get spurious results, in other words the OLS would not generate a consistent parameter estimator. Therefore, we need to do unit root tests to check whether data series are stationary or not.

**Table 2: Augmented Dickey-Fuller Unit Root Tests**[4]

| | Lag length | ADF statistics | First Differences | Lag length | ADF statistics |
|---|---|---|---|---|---|
| RM2D | 1 | -2.48 | △RM2D | 0 | -3.36** |
| RFCD | 1 | -0.88 | △RFCD | 2 | -2.98** |
| RGDP | 0 | -2.26 | △RGDP | 5 | -1.45 |
| INF_A | 3 | -2.67 | △△RGDP | 3 | -5.87*** |
| RF | 1 | -2.36 | △INF_A | 2 | -3.37** |
| DEPO | 1 | -1.67 | △RF | 2 | -4.29*** |
| DIFFER | 1 | -2.55 | △DEPO | 0 | -5.19*** |
| | | | △DIFFER | 1 | -6.69*** |

Note: 1) (**), (***) shows the variables are significant at 5%, and 1% levels, respectively.

2) In the First Differences column, all data series are at the 1st difference, except △△RGDP is the second difference.

3) Based on visual examination of data, the ADF tests are conducted with intercepts and trends at levels for RGDP, RM2D, RFCD and with intercepts only for the remaining variables. At the first difference, the ADF tests are conducted with intercepts only.

4) The unit root is conducted using lags length from 1 to 10. The reported result is chosen with the number of lags having minimum Akaike information criterion or Schwarz criterion.

[4] Following Dickey and Fuller (1979), the Augmented Dickey-Fuller test is used to run the regression:

$$\triangle Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j} + \mu_t$$

and then $$\triangle Y_t = \beta_1 + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j} + \mu_t$$

where $\triangle Y_t = Y_t - Y_{t-1}$; t denotes the time or trend variable; $\mu_t$ is the disturbances. To test $H_0$ ($\beta_2=0$, $\delta=0$) meaning $Y_t$ is non-stationary or has unit root at order one, a *F* ratio is calculated and check its significance by the Dickey and Fuller statistics.

The unit root test results are presented in Table 2. The results indicate all variables are I(1), except RGDP is I(2). However a general knowledge is that GDP should be I(1) or the growth rate of real GDP should be stationary. Herein, the matter that RGDP data is I(2) can be stemmed from the limited number of observations as there are only 48 observations. Therefore, in this case, we will base on general knowledge to consider RGDP as I(1) for our research analysis.

### 3.3 Cointegration Test

Engle and Granger (1987) indicated that if a linear combination of some non-stationary data series is stationary, it is called cointegrated and considered as long-run equilibrium relationship among the variables. As results of unit root test indicate that all the variables are I(1), this paper conducts cointegration test to estimate the long run demand for money if a cointegration exists. The method of Johansen (1988) is applied. Following Ibrahim (1999) and Sriram (1999a), since quarterly data are used, the analysis begins with eight lags and the test is repeated by reducing consecutively one lag at a time until the lag length reaches one.[5]

#### *3.3.1 Cointegration Test for Demand for M2 of Domestic Currency*

Variables RM2D, RGDP, INF_A, DEPO, RF are entered as endogenous variables in that sequence. A constant is also added. Since the variables are already seasonally adjusted, no seasonal dummy is necessary to add to the equation.

The result is presented in Table 3. They indicate that trace test supports 1 cointegration vector at 98% significant level and maximal eigenvalue test supports 1 cointegartion at 87% significant level. Thus, there is 1 cointegration at lag length of one. The long run demand for money can be written in the following equation (t-statistics in the parentheses):

$$RM2D = 2.7633 * RGDP + 4.2615 * DEPO - 3.1626 * INF\_A - 1.9407 * RF$$
$$\qquad\qquad (8.512) \qquad\quad (1.809) \qquad\quad (-3.945) \qquad\quad (-3.206)$$

[5] That the minimum number of lag length is 1 is based on Sriram (1999a). In his paper, the cointegration test of demand for M2 is conducted by monthly data with the lag length from 1 to 12 and this paper found the best cointegration result at 3 lags.

The result shows that the long run income-elasticity of money is 2.7633. This can be explained by the fact that since Vietnam is an economy in the process of monetization and the financial system is developing quickly,[6] the income elasticity can be much larger than 1. The income-elasticity of money shows that, if RGDP grows by 1%, ceteris paribus, the demand for real M2 of domestic currency would increase by 2.76%. This finding is generally in line with that obtained by Huang (1994), where he found the long run income-elasticity of money in China is 2.12.[7]

The own rate of money (DEPO) is positively affected RM2D, thus indicating that if, ceteris paribus, the domestic interest rate increases by one-percentage-point, the demand for real M2 of domestic currency increases by 4.26 percents. The semi-elasticity of inflation is -3.162, indicating that agents away from money holding to real assets when inflation is high. Like many developing countries, expected inflation has a strong impact on money demand in Vietnam.

**Table 3: Johansen Cointegration Tests for Money Demand**

| | | Trace Statistics | | | | | Maximum Eigenvalue | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Equation | $H_0$ | r = 0 | r≤ 1 | r≤ 2 | r ≤ 3 | r≤ 4 | r = 0 | r ≤ 1 | r≤ 2 | r ≤ 3 | r ≤ 4 |
| | $H_A$ | r ≥ 1 | r≥ 2 | r≥ 3 | r ≥ 4 | r≥ 5 | r ≥ 1 | r ≥ 2 | r ≥ 3 | r ≥ 4 | r ≥ 5 |
| RM2D | | 76.51* | 46.27 | 17.67 | 6.27 | 0.16 | 30.23 | 28.59* | 11.39 | 6.12 | 0.15 |
| RFCD | | 48.7** | 5.55 | 0.014 | | | 43.2** | 5.54 | 0.014 | | |
| | | 5% Critical Value | | | | | | | | | |
| RM2D | | 69.81 | 47.85 | 29.79 | 15.49 | 3.84 | 33.87 | 27.58 | 21.13 | 14.26 | 3.84 |
| RFCD | | 29.79 | 15.49 | 3.84 | | | 21.13 | 14.26 | 3.84 | | |
| | | Probability (%) | | | | | | | | | |
| RM2D | | 1.32 | 6.98 | 59 | 66.26 | 69.2 | 12.79 | 3.7 | 60.75 | 59.76 | 69.24 |
| RFCD | | 0.01 | 74.7 | 90.34 | | | 0 | 67.22 | 90.34 | | |

[6] An evidence of monetization process is the ratio M2/GDP (%):

| 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21.2 | 23.8 | 27.9 | 31.5 | 34.6 | 38.0 | 44.0 | 51.6 | 58.9 | 65.3 | 68.9 | 69.3 |

[7] Huang (1994) conducted cointegration test for China during 1979-1990 using quarterly data and found the following money demand: $m2_t = -8.58 + 2.12y_t + 1.56p_t - 0.29i_t$. Where m2 is real M2 (M2 = sum of cash and consumer's savings deposits (excluding deposits of enterprises)), *y* is real GNP, *p* is consumer retail sale price and *i* is real rate of interest on one-year saving deposits. Except *i*, all variables are in logarithm.

Notes: 1) r denotes the number of co-integrating vectors. 2) The asterisk (**), and (*) indicate the rejection of the null hypothesis at the 1 and 5% significance level.

If the expected rate of returns of USD increases by one-percentage-point, the demand for real M2 of domestic currency decreases by 1.94%. This result shows that asset substitution is happening in Vietnam. Interestingly, the long run coefficient on expected rate of returns of USD deposit (1.94) is lower than the long run coefficient of domestic interest rate (4.26) in absolute terms, suggesting that the own rate exercises more influences on demand for real broad money of domestic currency than rate of return of foreign financial assets. That implies domestic interest rate is still more important than rate of foreign return in determining demand for real broad money of domestic currency. This can happen due to domestic interest rate partly absorbed the effect of foreign rate of returns.

*3.3.2 Cointegration Test for Demand for Real Foreign Currency Deposits*

Variables RFCD, RGDP, DIFFER are entered as endogenous variables of the cointegration test in that order. A constant is also added. The variables are seasonal adjusted so no seasonal dummy is needed to add to the equation. A dummy variable (dum4) is added to the regression to reflect the strong depreciation of the domestic currency during the Asian financial crises. Dum4 has the value of one for periods of 1997:1-2 and 1997:4-1998:4 and zero for the others.

The test result is presented in Table 3. They indicate that, at 99.99% significant level, both trace test and maximal eigenvalue test support there is only one cointegartion, at lag length of one. The long run demand for real foreign currency deposits can be written in the following equation (t-statistic in the parentheses).

RFCD = 1.8768 * RGDP + 18.5026 * DIFFER

(4.0745) (7.8909)

The result shows that the long run income elasticity is 1.8768, which is higher than one, but lower than the long run income elasticity in the demand for real broad money of domestic currency (2.7633). That shows domestic currency is still the prefer currency in economic transactions. In other words, when income increases the demand for M2 of VND expands quicker than that of USD. The coefficient of RGDP (1.87)

also can be explained by the fact that the economy is in the monetization process so the income elasticity of money is larger than 1. The coefficient of speculation variable (DIFFER) strongly and positively (18.5206) affects real foreign currency deposits, thus indicating that if the difference between expected rates of returns of USD and VND increases by one-percentage-point (say from 1% to 2%/year), the demand for RFCD will increase by around 18%. This robustly affirms that the asset substitution is really a matter in the Vietnamese financial system and it is very important for the monetary authority to keep VND deposit interest rate higher than USD rate of return in order to keep the dollarization problem not being worsened. Demand for real foreign currency deposits is very sensitive to the difference between rates of returns of foreign and domestic currency deposits, especially exchange rate depreciation. A positive difference between rates of returns of foreign and domestic currency deposits triggers a shift from domestic financial assets and real assets to foreign financial assets, resulting in a lower inflation rate and a strong increase in demand for foreign money.

To summarize, some major findings are as followed:

- It is interesting to see that the long term money demand is existing in Vietnam. Previously, it was well believed by policy makers in the Vietnamese monetary authority as well as various financial researchers that it is difficult to find a highly statistical adequate long run demand for money model in Vietnam. Actually some efforts by international financial organizations as well as government agencies had been done, but failed to get any good results. To get this result, the research has carefully analyzed the Vietnamese financial market to find a proper model for this dollarized, in-transition economy and carefully choose the explaining variables in the model. The empirical results show that it is appropriate to separate the broad money into broad money of domestic currency and foreign currency deposits in order to formulate money demand models.

- The cointagration tests identified only one cointegration for real broad money of domestic currency and one unique cointegration for foreign currency deposits. The long run demand for real M2 of domestic currency is significant at 98% levels by trace test and 87% levels by maximum aigen value test, while the long run demand for real foreign currency deposits is significant at 99.99% levels by both tests. Hence, it is

reasonable to use monetary aggregates as one important factor in the set of intermediates targeting variables for monetary policy.

- In the model of demand for real M2 of domestic currency, the income elasticity is found to be 2.76, much larger than one, which can be explained that the economy is in monetization process. The variable employing the foreign effect is found to be the rate of return of USD deposit in terms of domestic currency. However, its direct effect to real M2 of domestic currency is found to be smaller than that of output, domestic interest rate and inflation rate. That can happen due to the government have used domestic interest rate for incorporating some effects of the rate or return of USD deposit in order to control exchange rate.

In the equation of demand for real foreign currency deposits, the variable that exercises the speculation effect turned out to be the difference between rates of returns of USD and domestic currency deposits. The semi-elasticity of this variable is very large, implicating the monetary authority should be very cautious in keeping domestic currency deposit rate higher than USD rate of returns in terms of domestic currency. Meanwhile, the income elasticity in RFCD equation is higher than 1 but smaller than the income elasticity in RM2D equation. Both of them can be explained by the fact that Vietnam is in the monetization process. The coefficient of income elasticity in RM2D equation (2.76) is judged to be more reasonable than that in RFCD equation (1.87) since the fact that the DEPO coefficient is higher than RF coefficient in RM2D equation shows that domestic currency, rather than USD, is used as the main currency in the economy.

- In order to have a well specified demand for money model, it is necessary to include interest rate as the own rate of return of money and inflation as rate of return of alternative real asset. Specifically, when a country like Vietnam, therein: (i) interest rate is rather rigid; (ii) the economy is in transition; (iii) inflation was decreased from a very high to a low level, it is still important to include both the own rate of money and rates of returns of alternative real asset in the model. Furthermore, when a country experiences a medium level of inflation, it is still important to include the rate of return of real asset since interest rate may not fully reflect changes in price level and agents tend to hold real assets when inflation is high.

### 3.4 Error Correction Model

Engle and Granger (1987) shows that the short run model provides information about how adjustment is taking place to restore the equilibrium in the long run money demand in response to the short run deviation. The error correction term is calculated from the vector error correction representing the demand for RM2D and RFCD. Since all variables in the short run model are stationary, the variables in the short run model will be the first differences of the variables in long run model, except the error correction term is at level. No seasonal dummy is needed to short run models as data is seasonally adjusted.

#### *3.4.1 Error Correction Model for Real Broad Money of Domestic Currency*

The error correction model for real broad money of domestic currency is derived from the following equation.

$$\Delta RM2D_t = \sum_{i=1}^{4} \beta_i \Delta RM2D_{t-i} + \alpha ECT_{t-1} + \sum_{j=0}^{4} \beta_j \Delta RGDP_{t-j} + \sum_{k=0}^{4} \beta_k \Delta DEPO_{t-k} + \sum_{m=0}^{4} \beta_m \Delta INF\_A_{t-m} + \sum_{n=0}^{4} \beta_n \Delta RF_{t-n} + \varepsilon_t$$

where error correction term $ECT_{t-1}=RM2D_{t-1}-RM2D^*_{t-1}$, or the error correction term is calculated as RM2D at time (t-1) minus the estimated RM2D from the cointegration vector (RM2D*) at that time. This stands for the excess money in the previous period. Based on the limited number of observations, the maximum number of lags should not exceed four. And the number of lags is chosen to be 4 based on the minimum Akaike information criterion.

Since all variable are stationary, the above model can be estimated by ordinary least squared (OLS). The unrestricted reduced form of the error correction model is reduced to a restricted reduced form of short run demand for RM2D by excluding the insignificant variables except the constant term. The following table displays the restricted error correction model.

The following discussion can be drawn from the analysis:

Firstly, the error correction term $ECT_{t-1}$ has the expected negative sign and very significant (at 0.01% level), which certifies the long run relationship in the cointegration test. The negative sign implies that money demand adjusted in the following quarter in response to the disequilibrium between money supply and money demand. If money supply exceeds money demand in the current quarter, agents will

restrict their money demand in the following quarters. The adjustment takes about 15 quarters or the existing disequilibrium will be decreased and disappeared after 15 quarters. This result is in line with the traditional view that money is largely passive in socialist economies (Bas and Nina, 1995).

**Table 4: Restricted Error Correction Model for Demand of Real Domestic Money**

| Variable | Coefficient | Standard error | t-statistic |
|---|---|---|---|
| C | 0.0291 | 0.0072 | 3.994*** |
| ECT(-1) | -0.0693 | 0.0129 | -5.344*** |
| △RM2D(-1) | 0.4642 | 0.0940 | 4.934*** |
| △RM2D(-2) | 0.5347 | 0.0947 | 5.643*** |
| △RM2D(-3) | -0.3179 | 0.1205 | -2.637** |
| △RM2D(-4) | -0.2383 | 0.0997 | -2.390** |
| △RGDP(-2) | 0.9837 | 0.3189 | 3.084*** |
| △RGDP(-3) | -0.8447 | 0.3433 | -2.459** |
| △DEPO(-1) | 1.1303 | 0.2158 | 5.236*** |
| △INF_A | -0.2228 | 0.0375 | -5.940*** |
| △INF_A(-4) | 0.1250 | 0.0398 | 3.139*** |
| △RF | -0.0966 | 0.0447 | -2.156** |
| △RF(-4) | -0.0804 | 0.0350 | -2.294** |

$R^2 = 0.876$ Adjusted $R^2 = 0.826$ DW = 1.765

Note: The asterisk (***), and (**) indicate the rejection of the null hypothesis at the 1 and 5% significance level.

Secondly, all four elasticity estimates of lags of demand for money (△RM2D) are significant at 5% levels, showing that the current money demand is depended on money demand of last four quarters. The absolute values of the coefficients are uniformly less than one. That indicates, in the short run, the growth rate of demand for money is inelastic to those of last three quarters. The values of the coefficients are

mixed but in total, it shows that changes in money demand in four previous quarters have positive recursive effects (0.4426) to changes in money demand in current period.

Thirdly, the signs of real output, inflation are mixed but their total recursive effects has signs as expected and all the coefficients are significant. The coefficients of domestic currency interest rate and USD rate of return are significant and have expected signs. RGDP coefficients have positive total recursive effects (0.139), total inflation coefficients have negative effect (-0.092).

The coefficient of domestic interest rate is positive and significant at 0.01% levels. The value of DEPO coefficient is 1.13 showing that demand for money is elastic to domestic interest rate even in the short run. If DEPO coefficient increases by one-percentage-point, demand for RM2D increases by around 1.13% in next quarter. The coefficient of DEPO in short run model (1.13) is smaller than that in the long run model (4.261), thus reflecting lags in monetary transmission mechanism. In other words, a one-percentage-point increase of domestic currency interest rate will increase broad money demand by 1.13 percents, but the effect in short term is smaller than the effect in long term since it needs some periods to pass the full effect of the increase in interest rate on to money demand.

The RF coefficients are negative and significant at 5% level, but the value of coefficients are small (-0.096 and -0.08). Interestingly, this result shows that, in the short run, the demand for VND is not elastic to rate of foreign return.

In terms of statistical adequacy of the ECM, the adjusted R squared (0.826) is accepted since regressions with first differences of the variables usually don't have high R squared.[8] The Durbin Watson (DW) statistic indicates the absence of a serial correlation in the ECM.

### *3.4.2 Error Correction Model for Real Foreign Currency Deposits*

The error correction model of real foreign currency deposits is derived from the following equation.

$$\Delta RFCD_t = \sum_{j=1}^{1} \gamma_j \Delta RFCD_{t-j} + \alpha ECT_{t-1} + \lambda \Delta DUM4 + \sum_{k=0}^{1} \gamma_k \Delta RGDP_{t-k} + \sum_{l=0}^{1} \gamma_l \Delta \mathrm{DIFFER}_{t-l} + \varepsilon_t$$

[8] Chowdhury (1993) found that the R-squared in short run money demand model are from 0.49 to 0.72. He considered these R-squared are normal for regression based on first differences in variables.

where the error correction term is calculated as $ECT_{t-1}$=$RFCD_{t-1}$-$RFCD^*_{t-1}$, in other words, RFCD at time t-1 minus the estimated RFCD at that time (from the cointegration vector). In line with the long run equation, a first difference of the dummy variable, △DUM4, is added to the short run equation. Since the data is quarterly and number of observations is limited, the maximum number of lags should not go beyond four and the lag length of 1 is chosen based on the minimum Akaike information criterion.

**Table 5: Restricted Error Correction Model for Demand of Real Foreign Currency Deposits**

| Variable | Coefficient | Standard error | t-statistic | Prob. |
|---|---|---|---|---|
| C | 0.0266 | 0.0070 | 3.775*** | 0.0005 |
| ECT(-1) | -0.0147 | 0.0061 | -2.381** | 0.0219 |
| △DUM4 | 0.0636 | 0.0180 | 3.530*** | 0.0010 |
| △RFCD(-1) | 0.4250 | 0.1147 | 3.702*** | 0.0006 |
| △DIFFER(-1) | -0.3654 | 0.1237 | -2.952*** | 0.0052 |

$R^2$ = 0.575 Adjusted $R^2$ = 0.534 DW = 1.736

Note: The asterisk (***) and (**) indicate the rejection of the null hypothesis at the 1 and 5% significance level.

The model can be estimated by ordinary least squared. The unrestricted reduced form of the error correction model is reduced to a restricted reduced form by eliminating insignificant coefficients.

The following discussion can be drawn from the analysis:

Firstly, the error correction term $ECT_{t-1}$ has the expected negative sign and is significant at 1% level. That validates the long run relationship in the cointegration test. The negative sign implies that money demand adjusted in the following quarters in response to the disequilibrium. The existing disequilibrium will be decreased and disappeared after 70 quarters.

Secondly, the elasticity estimate of the first lag of demand for money (△ RFCD) is significant at 1% level . The value of the coefficient is less than one,

indicating that, in the short run, the growth rate of demand for money is inelastic to its of last quarter as expected.

Thirdly, interestingly, in short run, RGDP doesn't play an important role in determining demand for money. In the long run, RGDP is significant. However, in the short run, changes in output have no role to explain the changes in the demand for RFCD. In addiction, unlike the long run equation, the coefficient of DIFFER in the previous period has negative and significant effect on money demand, although the coefficient in short run model (-0.36) is small.

In terms of statistical adequacy of the ECM, both the adjusted $R^2$ (0.534) and the Durbin Watson (2.342) statistic are accepted.

### 3.5 Impulse Responses

The impulse response maps the effects of a variable's shock on all variables in the vector error correction model. In this section, we will investigate three impulse responses: (i) responses of real broad money of domestic currency, output, domestic interest rate, and inflation to one time shock of USD rate of returns; (ii) responses of RM2D to an unanticipated change in other variables; and (iii) responses of RFCD, RGDP to one time shock of DIFFER. In other words, we will trace the effects of a one-time shock to RF and DIFFER on current and future values of other variables in their models, respectively as well as map out the effects of unanticipated changes in other variables on RM2D. Based on standard macro economic theory, the order of the variables in the impulse responses and variance decompositions is selected as follows: RF, DEPO, RM2D, RGDP, INF_A.

#### *3.5.1. Impulse Responses of Variables in RM2D Model to One Time Shock of USD Rate of Return*

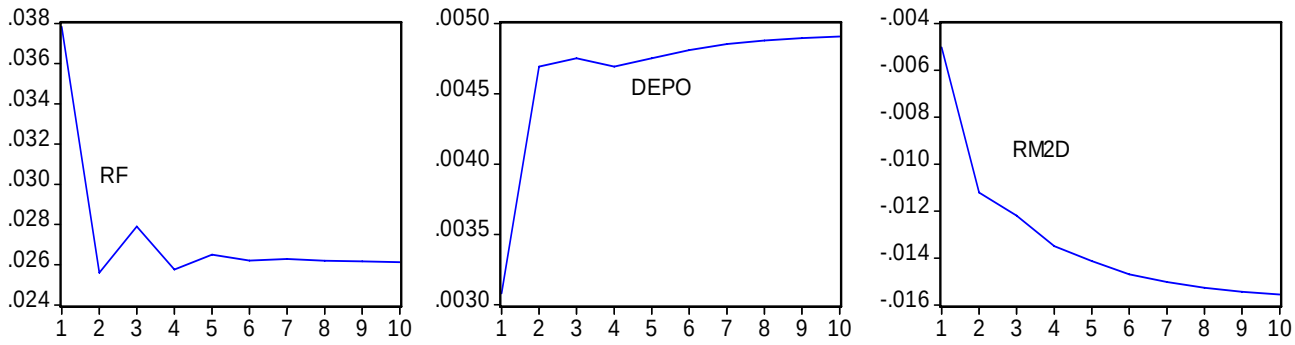
The reason we are interested in RF shock is that this shock can be considered as an external shock to the economy and we will see how such a small dollarized transition economy reacts to the external shock.

The shock of RF will increase RF in first quarter (Figure 3) but the overshooting increase will decrease in the second quarter. However, the shock results in a long term increase in RF by around 2.4%. The interest rate of domestic currency

responds quickly to the shock of rate of foreign returns by one standard deviation. Domestic interest rate increases immediately and after 2 quarters, domestic interest rate is around 0.47 points higher than its pre-shock level and fluctuates slightly around that in the following quarters. The response partly reflects the uncovered interest rate parity in the financial market and the persistence at a higher level of domestic currency interest rate in response to USD rate of return shock can help to explain the interest rate policy which aims to keep a higher interest rate in response to the increase in rate of foreign return in order to prevent a currency flight to USD.

In response to shock of rate of return of USD, demands for M2 of domestic currency and inflation decrease immediately (Figure 3&4). In the following quarters, real M2 of domestic currency still decreases further since people are averse to shocks in rate of return of USD. From the fourth quarter, inflation is around 0.48%/year lower than its pre-shock level.

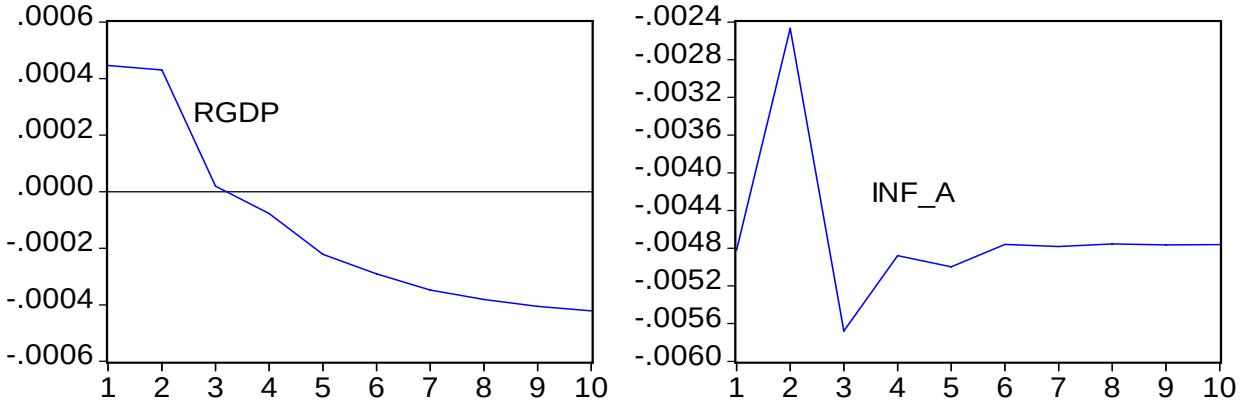
**Figure 3: Responses of RF, DEPO and RM2D to Cholesky One Standard Deviation of RF Innovation (1993:01 –2004:4)**




Real output increases at two first quarters but it decreases in later periods (Figure 4). This can be explained as follows: when there is an unanticipated change in RF, demand of USD increases and causes central bank to keep the foreign reserves by directly or indirectly limiting the sell of foreign exchange to importers, thus leading to the temporary decrease in import and temporary increase in RGDP. But in the aftermath, RGDP decreases due to the strong depreciation make people became uncertainty about future and the higher domestic interest rate has affected negatively

the economic growth. In the contrary to J-curve effect, a strong depreciation in Vietnam will increase very slightly GDP in very short term but decrease GDP very slightly in later periods. The decline of inflation coincides with the decline of RGDP and RM2D, besides the higher domestic interest rate also leads to lower inflation rate.

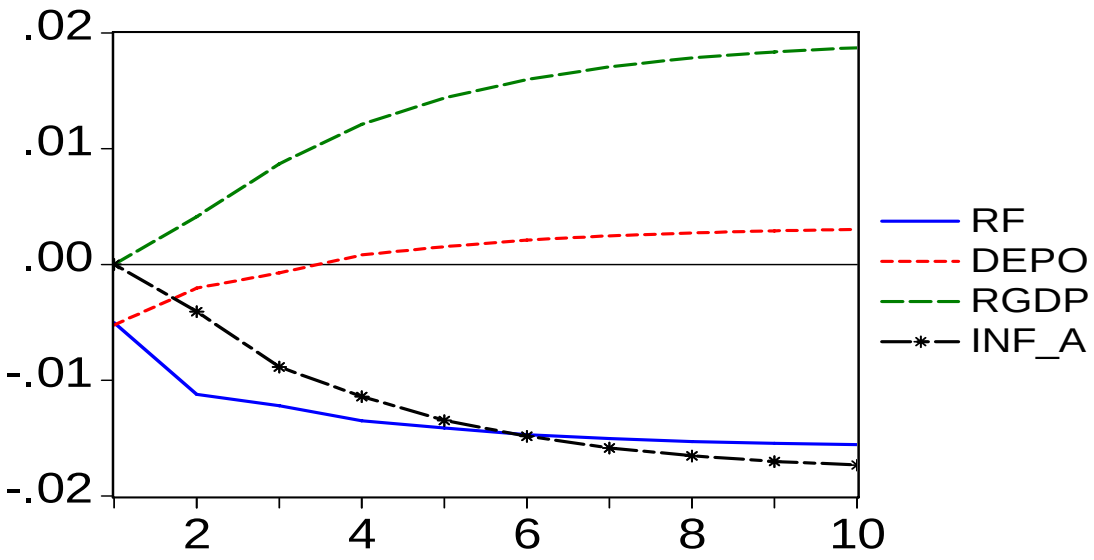
**Figure 4: Responses of Inflation and Output to Cholesky One Standard Deviation of RF Innovation**




*3.5.2. Impulse Responses of RM2D to One Time Shock of Other Variables*

Next, we examine the impulse response function of RM2D as a way to measure how the real domestic money demand responds to shocks of other variables (Figure 5). When there is a shock to RGDP, real domestic money demand will increase as the demand for money in transaction increases. We can see that the response of RM2D to RGDP innovation is stronger and stronger, showing that RM2D has strong response to RGDP shock in long run. In response to the shock in inflation, the real domestic money demand will decrease as higher inflation make people shifted from domestic money to real asset.

**Figure 5: Responses of RM2D to Cholesky One Standard Deviation of RF, DEPO, RGDP and INF_A Innovations (1993:01-2004:4)**



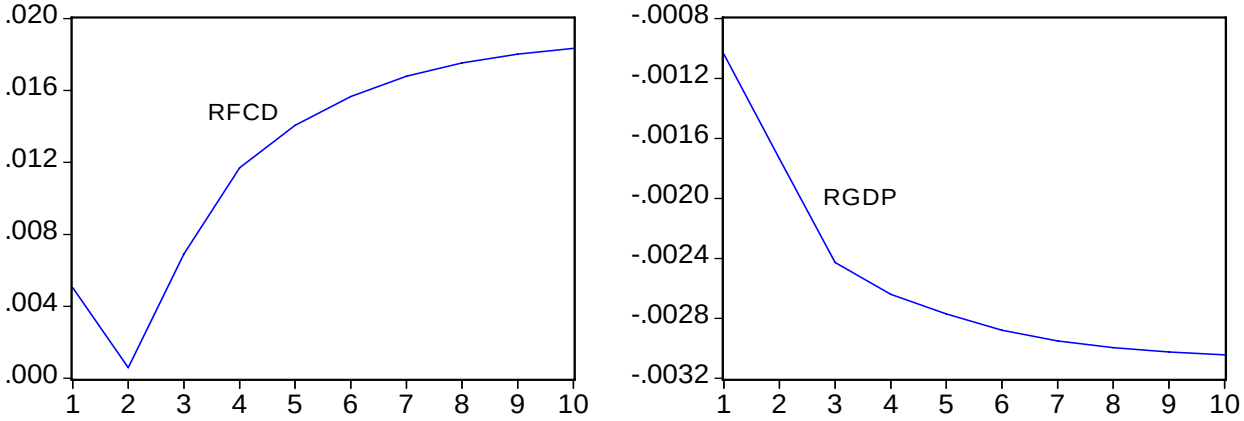

As the rate of return of FCD increases, the demand for real domestic money will decrease. Inflation and rate of foreign return influence on RM2D as strong as GDP does but in opposite direction. The increases of inflation and rate of foreign return decrease the demand for real broad money of domestic currency. Initially, the increase of interest rate or a contractionary monetary policy will cause the money aggregate to decrease but this effect lasts around 3 quarters. From the 4$^{th}$ quarter, the increase in interest rate caused by contractionary monetary policy raises the demand for real broad money of domestic currency, but the level of increase is small. The effect of DEPO dies out quickly, which means that shock of domestic interest rate only affects real domestic money demand in short run. In long run the domestic rate innovation has no considerable effect on RM2D.

*3.5.3. Impulse Responses of RFCD and RGDP to One Time Shock of DIFFER*

In the following part, this paper conducts the impulse responses for variables in the demand for real foreign currency deposits equation to one time shock of differences in rates of returns of VND and USD deposits. The reason we are interesting in this test is that DIFFER can be arisen from an external factor (changes in USD interest rate in world market), changes in exchange rate or changes in monetary policy by adjusting the interest rate, thus these changes can be arisen from the policy intentions or has potential strong effects on a small, open economy.

Based on an understanding that changes in the difference between rates of returns of domestic and foreign currency deposits should precede the changes in the holding of foreign money, which in its turn will affect output, the order of variables is decided as follows: DIFFER, RFCD, RGDP.

**Figure 6: Responses of RFCD and RGDP to Cholesky One Standard DIFFER Innovation**




We can see that when there is one standard deviation shock to DIFFER, RGDP will decrease (Figure 6), even though the level of decrease is not large. For RFCD, it increases immediately, decreases at the 2nd quarter and increases again from the 3rd quarter. This can be explained as followed: when there is a shock to DIFFER, people will rush to buy USD, but when the DIFFER decreases the speculator will sell USD so the RFCD decreases at second quarter or there is an overshooting effect in first quarter. At the 3rd quarter, people will buy USD to protect money value as they are averse to the uncertainties in the future regarding the difference between domestic and foreign returns.

### 3.6 Variance Decompositions

Enders (1995) shows that variance decomposition splits variance of forecast errors for one variable into contributions of shocks of other variables in vector error correction model, thus stating how important each innovation is in effecting the variables in vector error correction model. In this section, variance decomposition is

conducted to characterize the dynamic behavior of: (i) rate of foreign return, inflation, domestic interest rate, RGDP and RM2D in the equation of RM2D; and (ii) real foreign currency deposits in the equation of RFCD.

*3.6.1 Variance Decompositions of Rate of Foreign Returns*

The variance decompositions as presented in Table 6 suggest that most of the variance of the forecast errors of foreign return is explained by shocks in itself. Inflation is the only factor affecting considerably exchange rate. That can be explained by the fact that the exchange rate is strongly controlled by central bank, therefore interest rate, output, money demand has small role in influencing exchange rate.[9] However, inflation is still an important factor affecting exchange rate, partly reflecting the purchasing power parity.

**Table 6: Variance Decompositions of Rate of Foreign Returns**

| Period | S.E. | RM2D | RGDP | DEPO | INF_A | RF |
|---|---|---|---|---|---|---|
| 1 | 0.017 | 0.000 | 0.000 | 0.000 | 0.000 | 100.00 |
| 2 | 0.031 | 1.307 | 0.004 | 2.211 | 2.628 | 93.84 |
| 3 | 0.046 | 1.187 | 0.008 | 1.627 | 2.344 | 94.83 |
| 4 | 0.059 | 1.205 | 0.085 | 1.315 | 3.144 | 94.25 |
| 5 | 0.072 | 1.138 | 0.255 | 1.089 | 4.472 | 93.04 |
| 6 | 0.084 | 1.085 | 0.458 | 0.927 | 5.506 | 92.02 |
| 7 | 0.096 | 1.025 | 0.641 | 0.805 | 6.343 | 91.18 |
| 8 | 0.106 | 0.971 | 0.802 | 0.712 | 7.004 | 90.50 |
| 9 | 0.116 | 0.922 | 0.940 | 0.638 | 7.552 | 89.94 |
| 10 | 0.126 | 0.880 | 1.060 | 0.578 | 8.012 | 89.46 |

Cholesky Ordering: RF DEPO RM2D RGDP INF_A

*3.6.2 Variance Decompositions of Domestic Interest rate*

Variance decomposition also conducts to find the attributes to variance of the forecast errors of domestic interest rate (Table 7). It can be seen clearly that foreign

[9] According to IMF classification in 2004, Vietnam is under the exchange rate arrangement of managed floating with no pre-determined path for the exchange rate.

return has very important effect on domestic rate in short run as well as long run. In the first quarter, 14.5% of DEPO variance is explained by unanticipated shocks of RF. After 10 quarters, this ratio increases to nearly 19.5%. In short run, foreign return shock has importance effect on DEPO and this effect still continue in longer periods. This partly reflects the uncovered interest parity condition. However, in return, DEPO shock has no considerable effect on RF in short run as well as longer run as indicated in Table 6. Offsetting the shock from an increase of foreign rate of returns seems a very important mission of domestic interest rate. INF_A and RM2D shocks have weak effects on DEPO in short run but the effect is stronger in long run. After 10 quarters, INF_A and RM2D accounts for around 10.5% and 8.48% variances, respectively. Interestingly, GDP shock does not affect interest rate in short run as well as in longer periods.

**Table 7: Variance Decompositions of Domestic Interest rate**

| Period | S.E. | RM2D | RGDP | DEPO | INF_A | RF |
|---|---|---|---|---|---|---|
| 1 | 0.005 | 0.000 | 0.000 | 85.506 | 0.000 | 14.493 |
| 2 | 0.008 | 2.850 | 0.033 | 75.077 | 4.909 | 17.128 |
| 3 | 0.010 | 4.277 | 0.143 | 70.257 | 7.523 | 17.798 |
| 4 | 0.012 | 5.289 | 0.360 | 67.580 | 8.593 | 18.176 |
| 5 | 0.014 | 6.119 | 0.552 | 65.667 | 9.113 | 18.547 |
| 6 | 0.016 | 6.802 | 0.715 | 64.150 | 9.485 | 18.845 |
| 7 | 0.018 | 7.356 | 0.857 | 62.905 | 9.803 | 19.076 |
| 8 | 0.020 | 7.806 | 0.983 | 61.874 | 10.083 | 19.252 |
| 9 | 0.021 | 8.174 | 1.094 | 61.016 | 10.327 | 19.387 |
| 10 | 0.023 | 8.480 | 1.190 | 60.296 | 10.536 | 19.496 |

Overall, the interest rate policy aims at offsetting the shock from foreign rate of returns in short run. In a longer run, interest rate policy aims at maintaining exchange rate and price stability and shock from money demand. However, the weakness of interest policy is that it has no role in stabilizing output.

*3.6.3 Variance Decompositions of Output and Inflation*

For output, almost 90% of its variances is explained by itself (Table 8).

Interestingly, RM2D accounts for 10.95% of forecast errors of output at the 1st quarter but this contribution has *decreased* quickly and after 3 quarters, the contribution become much smaller. Interestingly, like a classical economy, broad domestic money balance only affect output in short periods and has no effect in longer periods. Inflation, foreign return and interest rate shocks only affect very slightly output.

For inflation, at the first quarter, around 29.4 and 11.8% of its variance come from shock of domestic rate and RM2D, respectively (Table 8). But after 10 quarters, the contribution of RM2D increases to 24.9%, while that of domestic rate decrease slightly to 22%. This confirms the very important role of monetary policy in controlling inflation. The results show that monetary policy is responsible for up to 40-45% of the inflation variances. Changes in oil prices, food prices, etc are reflected in the inflation shocks and 48-57% of forecast errors of inflation are explained by the inflation shocks.

**Table 8: Variance Decompositions of Output and Inflation**

Variance Decomposition of RGDP:

| Period | S.E. | RM2D | RGDP | DEPO | INF_A | RF |
|---|---|---|---|---|---|---|
| 1 | 0.041 | 10.945 | 87.203 | 1.207 | 0.000 | 0.644 |
| 2 | 0.053 | 5.439 | 92.622 | 1.198 | 0.171 | 0.567 |
| 3 | 0.060 | 3.309 | 94.070 | 2.099 | 0.177 | 0.343 |
| 4 | 0.065 | 2.528 | 94.218 | 2.728 | 0.283 | 0.240 |
| 5 | 0.070 | 2.276 | 93.877 | 3.206 | 0.438 | 0.202 |
| 6 | 0.074 | 2.249 | 93.405 | 3.518 | 0.638 | 0.189 |
| 7 | 0.078 | 2.305 | 92.923 | 3.738 | 0.842 | 0.189 |
| 8 | 0.082 | 2.392 | 92.481 | 3.897 | 1.032 | 0.195 |
| 9 | 0.086 | 2.484 | 92.094 | 4.017 | 1.200 | 0.202 |
| 10 | 0.090 | 2.571 | 91.761 | 4.111 | 1.345 | 0.210 |

Variance Decomposition of INF_A:

| Period | S.E. | RM2D | RGDP | DEPO | INF_A | RF |
|---|---|---|---|---|---|---|
| 1 | 0.037 | 11.834 | 0.084 | 29.413 | 57.348 | 1.318 |
| 2 | 0.047 | 13.310 | 1.398 | 25.710 | 58.547 | 1.032 |
| 3 | 0.054 | 15.436 | 2.022 | 24.325 | 56.551 | 1.664 |
| 4 | 0.061 | 17.628 | 2.291 | 23.582 | 54.532 | 1.965 |
| 5 | 0.067 | 19.547 | 2.371 | 23.129 | 52.733 | 2.217 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 0.073 | 21.099 | 2.412 | 22.783 | 51.328 | 2.376 |
| 7 | 0.078 | 22.335 | 2.438 | 22.510 | 50.210 | 2.504 |
| 8 | 0.083 | 23.338 | 2.463 | 22.283 | 49.310 | 2.604 |
| 9 | 0.088 | 24.169 | 2.484 | 22.092 | 48.564 | 2.688 |
| 10 | 0.092 | 24.870 | 2.503 | 21.930 | 47.936 | 2.759 |

Cholesky Ordering: RF DEPO RM2D RGDP INF_A

*3.6.4 Variance Decompositions of Real Foreign Currency Deposits*

The variance decomposition of RFCD (Table 9) affirms that, in line with the error correction model, output has no role in explaining the variance of forecast errors of real foreign money. Most of the variances of real foreign currency deposits are explained by themselves. The difference between rates of returns of foreign and domestic deposits has some roles in explaining the variances of RFCD as explained in section 3.5.3 about the response of RFCD to the impulse of DIFFER.

**Table 9: Variance Decompositions of Real Foreign Currency Deposits**

| Period | S.E. | RFCD | GDP | DIFFER |
|---|---|---|---|---|
| 1 | 0.0400 | 98.4135 | 0 | 1.5864 |
| 2 | 0.0711 | 99.4641 | 0.02723 | 0.5086 |
| 3 | 0.0966 | 99.1198 | 0.09024 | 0.7898 |
| 4 | 0.1195 | 98.4307 | 0.09407 | 1.4752 |
| 5 | 0.14069 | 97.8488 | 0.08743 | 2.0637 |
| 6 | 0.1602 | 97.3713 | 0.08150 | 2.5471 |
| 7 | 0.1783 | 96.9800 | 0.0765 | 2.9434 |
| 8 | 0.1951 | 96.6638 | 0.07234 | 3.2638 |
| 9 | 0.2109 | 96.4081 | 0.06895 | 3.5229 |
| 10 | 0.2258 | 96.1995 | 0.06619 | 3.7342 |

Cholesky Ordering: DIFFER RFCD GDP

## IV. CONCLUSIONS

This paper has estimated the long run and short run demand for real money balance for Vietnam and analyzed some characteristics of the economy by using impulse responses and variance decomposition techniques to interpret what happen to the economy when there is a shock to some major macroeconomic variables. Solving the puzzle of negative correlation between broad money and inflation after the outburst of Asian financial crisis, the paper formulates demand for money by estimating demand for real broad money of domestic currency and demand for real foreign currency deposits. A number of interesting and very useful analyses of the Vietnamese economy are also found. Some important conclusions are as follows:

Firstly, the research has found the long run demand for real money in Vietnam by estimating the long run demand for real broad money of domestic currency and the long run demand for real foreign currency deposits. The empirical result shows that the long run demand for real broad money of domestic currency is determined by income (with elasticity of 2.7633), domestic interest rate (with semi-elasticity of 4.2615), inflation rate (semi-elasticity of -3.1626) and rate of return of USD deposits (semi-elasticity of -1.9407). The long run demand for real foreign currency deposits is determined by income (with elasticity of 1.8766) and the difference between rate of returns of foreign and domestic deposits (with semi-elasticity of 18.5026). The result also shows that it is reasonable to use monetary aggregates as one important factor in the set of intermediates targeting variables for monetary policy.

The direct effect of rate of foreign return to real broad money of domestic currency is found to be smaller than that of output, domestic interest rate and inflation rate. That can happen due to the government have used domestic interest rate for incorporating some effects of the rate of return of USD deposit in order to manage foreign exchange market. In the model of demand for real foreign currency deposits, the variable that exercises the speculation effect turns out to be the difference between rate of return of USD and yield of domestic currency deposit. The semi-elasticity of this variable is very large, implicating asset substitution is a really matter in the Vietnamese financial system. The income-elasticity in both models is around two,

which can be explained by the fact that Vietnam is in the monetization process and the financial system is developing quickly.

Secondly, in the short run model of demand for real broad money of domestic currency, the value of error correction term shows that it takes 15 quarters to adjust the disequilibrium between money supply of VND and money demand of VND. Interestingly, in both the short and long run models, domestic interest rate evidenced the most important factor in determining demand for real broad money of domestic currency.

The short run model of demand for real foreign currency deposits evidenced that output has no role in determining demand for real foreign currency deposits in short run.

Thirdly, the impulse responses show that an unanticipated shock of rate of return of USD deposit increases domestic interest rate, that is in line with uncover interest parity condition, and decreases the demand for real broad money of domestic money and inflation. Interestingly, contrary to J-curve effect, a strong depreciation will increase very slightly GDP in very short term but decrease GDP very slightly in later periods. In other words, a strong depreciation does not affect GDP significantly.

In short run, domestic money demand is affected by rate of foreign return and domestic interest rate. Interestingly, the effect of domestic interest rate on real broad money of VND dies out gradually. In longer periods, demand for real broad money of domestic currency is influenced by shocks on output, inflation and rate of foreign return.

The shock of the difference between rates of returns of USD and VND deposits will increase considerably the real foreign currency deposit and decrease slightly output.

Fourthly, the result of variance decomposition affirms that the interest rate policy aims at offsetting the shock from rate of foreign returns in the short run. In the long run, the policy targets maintaining exchange rate and controlling price. However, the weakness of interest policy is that it has no role in stabilizing output; this can be due to the rigid interest rate policy of central bank.

The empirical results also affirm that interest rate, output, money balance has no role in influencing exchange rate, that can be explained by the fact the exchange rate

is strongly controlled by central bank. However, inflation is still an important factor affecting exchange rate, reflecting the purchasing power parity.

Interestingly, like a classical economy, output is affected considerably by broad domestic money balance only in the first two quarters and this effect will be decreased after that. Interestingly, this paper empirically found the very important role of monetary policy in determining inflation, which partly help to make clear a confusion among Vietnam economy's researchers that whether inflation in Vietnam caused by money supply. The result indicates that the current target of monetary policy in Vietnam of stimulating economic growth by a long-lasting expansionary monetary policy seems to be improper. That policy only raises output in very short term, but results in higher inflation forcing exchange rate to be depreciated in longer periods. The result shows that monetary policy shocks are responsible for 40-45% of the forecast errors of inflation, showing the very important role of monetary policy in controlling inflation in Vietnam. Changes in oil prices, food prices, etc are reflected in the inflation shocks and 48-57% of forecast errors of inflation are explained by the inflation shocks.

Lastly, the result of this research has very important meaning to Vietnam. This model is the first money demand model of Vietnam modeling money demand by separating the demand for broad money into demand for real M2 by domestic currency and demand for real foreign currency deposits. The results may help to improve the effectiveness of monetary policy by providing a fundamental tool to set up the financial programming in order to help monetary policy control prices better. The accomplishment of this research also partly realizes the possibility of setting up econometric models to use in policy making and economic analysis in Vietnamese economy. Besides, it contributes to the body of research about money demand in dollarized economies

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