STABILITY OF MONEY DEMAND IN VIETNAM

Application of the bounds testing approach on 1999 – 2011

Ngoc-Anh Lai[1,2]

Abstract By adopting the bounds testing for cointegration framework in Pesaran et al. (2001), this paper investigates the dynamics of money demand in Vietnam from 1999 to 2011. The empirical result delivers strong evidence for a long-run relationship between money demand and income, expected inflation, exchange rates and gold price, regardless of M1, M2 or M2 without foreign currency deposits is considered. The stock price movements only matter in M2 and M2D. More crucially, the stability test conclusion points out the presence of stable money demand in Vietnam only for M1 and M2D while M2 demand manifesting some temporary instability. This results in the need of calling into question the actual monetary targeting strategy of the Central bank.

JEL classification E41, C22

Keywords Money demand, bounds testing, ARDL, Stability, Vietnam

Version of February 25, 2013

[1] Centre d'Economie de la Sorbonne, Université Paris 1 Panthéon-Sorbonne, 106-112 Boulevard de l'Hôpital, 75647 Paris Cedex 13, France. Email: l_n_anh@yahoo.fr. Phone: 00 33 1 44 07 82 77. Fax: 00 33 1 44 07 83 01.

[2] This paper is based on the author's Ph.D. thesis at Université Paris 1 Panthéon-Sorbonne, entitled "Central bank in macroeconomic regulation: The case of Vietnam" under the supervision of Professor Christian Bordes. She wishes to gratefully acknowledge Professor Bordes for his helpful comments.

Abbreviations

AIC	Akaike's Information Criteria
ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
BIC	Schwarz's Bayesian Information Criteria
CPI	Consumer Price Index
CUSUMSQ	CUSUM squared test
ECM	Error Correction Model
FCD	Foreign Currency Deposits
GDP	Gross Domestic Product
IFS	International Financial Statistics
IMF	International Monetary Fund
SBV	State Bank of Vietnam
USD	United States Dollar
VECM	Vector Error Correction Model
VND	Vietnam Dong

1. Introduction

Money demand study is essential for the conduct of monetary policy, especially in a monetary targeting framework. Once the money demand function remains stable, the relationship between monetary aggregates and their determinants could deliver accurate signals for setting an appropriate policy stance; macroeconomic outcomes would then be predictable.

Likewise, understanding the demand for money is apparently crucial for an efficient implementation of monetary policy of the State Bank of Vietnam (SBV). Since the central bank has been following a monetary targeting strategy, the effectiveness of its monetary policy rests for a large part on the capability of defining a pertinent money demand function and the stability of the latter. This task has never, however, been easy, particularly during such a dynamic period as the 2000s with growing trend of financial liberalization and innovations in the world, and also intrinsic developments of the economy.

The policy shift from central planning to market regulation in late 1980s has brought in rapid economic growth and also an important foundation for substantial financial progressions during the last two decades, resulting in increasing monetization and financial deepening in the country. This could have had impacts on money demand through income effect of higher revenue or substitution effect of newly available assets. However, the presence of persistent and high inflation has been able to reduce the residents' preference for domestic currency. Meanwhile, Vietnam has for long experienced dollarization phenomenon and as the current account has been gradually liberalized, it would be appropriate to be aware of some intervention of international variables in the money demand function.

Although there have been a great number of works on the demand for money for both developed and developing countries, there are only a few published studies on Vietnam, and merely one of them considers the stability of the money demand (Nguyen and Pfau 2010). Given this scarcity, this paper is aiming to analyze the stability of the demand for money in Vietnam by firstly specifying the most relevant money demand function. Taking into account several evolutions in the national as well as global macroeconomic environment during the last two years, the re-visitation of the subject is worth pursuing. Besides, it is interesting to include a new variable in the money demand function in the case of Vietnam. Indeed, the gold price is a highly potential candidate since Vietnamese residents have a habit of holding gold, apart from USD, as a store of value, and often react forcefully against the rise and fall of the price of gold. To the best of our knowledge, this is the first time the gold price is incorporated in the money demand function. Additionally, this study also benefits from the new econometric technique developed by Pesaran et al. (2001) named the bounds testing approach or Autoregressive Distributed Lag (ARDL) approach for cointegration, suitable for small sample estimation, which has not been done before for the case of Vietnam.

The paper is organized as follows. The next section sketches out a picture of the Vietnam economy while section 3 reviews some recent empirical researches on the money demand for developing

countries, including those on Vietnam's. Section 4 demonstrates in detail the methodology, the variable and data selection, and the results of our practical analysis. Section 5 concludes.

2. Vietnam economy overview

The profound reform program of *Doi Moi* initiated in late 1980s, by dismantling the central planning system to move towards the market economy, did release previously confined economic sources of dynamism. Vietnam has made significant progress in socio-economic development and gained growing confidence of investors since then, and became a middle-income country in 2009. These achievements were essentially attained through two phases of reforms *Doi Moi* 1 (1986-1996), and *Doi Moi* 2 (2001-2007). The first phase succeeded in opening the economy to international trade and investment. However, the public sector which is usually characterized with both low productivity and profitability was too privileged in the trade and investment system. It could not help maintain growth especially under the impact of the 1997 Asian crisis, resulting in economic slowdown in 1999-2000 with deflation, decreasing foreign investment inflows and exports. Therefore, the second phase of reforms was implemented, aiming to unleash the domestic private sector. The country recognized a period of high growth again, until it was touched by the global financial turmoil in 2008 when in association with slower economic growth, inflation registered its highest level since 1992 (see Figure 4 in the Appendix). Still, two-digit inflation has not been uncommon for Vietnamese people, which is one of the most important preoccupations of both local residents and policymakers. Such strong and enduring erosion of the dong has driven inhabitants to run towards other assets like real estate or gold, and USD.

In parallel with macroeconomic renovation, substantial banking and financial sector reforms also have been performed. The deregulation of domestic interest rates[3] since 1996, the establishment of the national stock exchange in 2000 (Figure 4), the restructuring of state-owned commercial banks since 2005 and the openness for 100% foreign-owned banks from 2008 are the most important steps of financial reforms taking place in the nation (Leung 2009). Consequently, high monetization and financial deepening have been recorded in Vietnam since 2000[4]. Nonetheless, with a nascent stock exchange and extremely weak bond market, the Vietnam financial system is still underdeveloped and highly bank-based.

The ministerial agency in charge of conducting such reforms in the financial sector is the SBV. Following a monetary targeting strategy, the SBV uses reserve money as its operational target to adjust broad money (M2 exclusively) and credit growth – intermediate targets – in order to reach the final goal of price stability. From the IMF point of view (IMF 2010), the SBV actually integrates an exchange rate targeting in its monetary policy strategy. Indeed, the central bank releases a reference bilateral exchange rate vis-à-vis the USD on a daily basis, which is considered the central parity or the target, and allows the dong to trade within a certain symmetric band[5]. Yet,

[3] However, in some specific situations like high inflation, certain restrictions on interest rates are applied. For example, the maximum rate of interest on deposits at banks was fixed at 14% per annum for 2011.

[4] M2/GDP and Credit/GDP ratios have increased dramatically, from 29% in 1999 to over 110% (M2/GDP) and over 135% (Credit/GDP) in 2010.

[5] Since mid-2008, the SBV has intervened more frequently and more vigorously but still followed its strategy.

the actual monetary policy does not seem to work well. Beside recurrent violations of intermediate targets[6], the final objective of stability of the national currency value has not been guaranteed either. In addition, the exchange rate targeting has also encountered many difficulties due to the existence of a dynamic parallel market for foreign exchanges and durable dollarization phenomenon.

Considering all these destabilizing factors responsible for eventual instability of the dong demand and the present policy inefficiency, the viability prospects of the actual monetary targeting regime of the SBV is likely called into question. By examining the stability of the money demand in Vietnam, this paper attempts to conclude on whether the central bank should continue on its path because a stable money demand is a crucial foundation for such a monetary policy strategy.

3. Literature review

Wishing to understand an issue of such importance as the demand for money, there has been a vast stream of researches carried out worldwide over the last decades. While money demand empirical studies on developed countries at first dominated, the number of works on developing economies has been augmented steadily. One can refer to Knell & Stix (2004) for a useful summary of the main findings in the literature since the 1970s. By analyzing almost a thousand of money demand estimations, they found that despite large dispersions concerning time periods, countries or estimation methods among others, it is possible to extract some common features from these studies. The estimates of income elasticity are close to one, but tend to be larger when a broad rather than a narrow monetary aggregate is used. It could also be varied if proxies for wealth or financial innovations are included. As regards the opportunity cost of holding money, it is found to play an important role in determining money demand and be negatively related to the latter.

In empirical researches, the error-correction models (ECMs) or cointegration framework has proved to be the most successful tool in money demand estimation (Sriram 1999). Beside two principal approaches of Engle & Granger (1987) and Johansen & Juselius (1990), the bounds testing procedure, or the Autoregressive Distributed Lag (ARDL) approach, proposed by Pesaran et al. (2001) has progressively been employed[7] when analysing the demand for money. The main advantage of this approach is that it does not require all variables to be I(1) as the Johansen framework but still being applicable if the dataset contains a mixture of I(0) and I(1) variables, thus does not add some uncertainty into the analysis caused by the stationary pre-testing. Achsani (2010) found that the ARDL approach is more appropriate in predicting money demand function in compare to Johansen procedures for the case of Indonesia. In addition, S. Narayan & P. K. Narayan (2005) and P. K. Narayan & Smyth (2006) state that this bounds testing procedure is not disturbed even if the sample is small.

With reference to the money demand stability, the empirical literature does not always show unanimity on this topic. In most cases, the stability tests proposed by Brown et al. (1975), namely

[6] Since 2004, effective M2 and Credit growth rate have always outweighed their targets announced by the SBV.

[7] See Bahmani-Oskooee (2001), Akinlo (2006), Bahmani-Oskooee & Wang (2007), Tang (2007), Samreth (2009), Baharumshah et al. (2009), Azim et al. (2010), Dagher & Kovanen (2011) and Dahmardeh & Izadi (2011) for instance

CUSUM and CUSUMSQ test, are applied but some studies demonstrate signs of temporary instability of the money demand. As in Bahmani-Oskooee & Rehman (2005), for a set of Asian developing countries, they find that for some countries M1 is not stable all over the sample period even though the money demand is cointegrated with its predictors. Samreth (2009), Azim et al. (2010), Padhan (2011) and Dritsakis (2011) share similar conclusions for the case of Cambodia (M1), Pakistan (M1,2), India (M3) and Hungary (M2). Meanwhile, Kumar (2011) detects that M1 demand in twenty developing Asian and African are not affected by financial reforms, remain stable over 1975-2005 period as a consequence. Having comparable results there are Akinlo (2006) on M2 of Nigeria, Bahmani-Oskooee & Wang (2007) on M1 and Baharumshah et al. (2009) on M2 of China, Tang (2007) on M2 of Japan and Dagher & Kovanen (2011) on M2 of Ghana among others.

Only a few empirical studies are focused on the money demand in Vietnam, differing by time period, monetary aggregate, data frequency and model specification. Adam et al. (2004) estimates demand for narrow money, M1, by using monthly data from January 1991 to June 1999, trying to extract the precise currency substitution effect from the money demand in Vietnam. They argue that in the presence of currency substitution, the competition between monies in financing transactions can be illustrated by the income elasticity of money demand being a function of the expected rate of domestic currency depreciation that implies a non-constant elasticity. Using a Vector Error Correction Model (VECM), they find that in long run, people switch from one currency to another for transaction motive but in short run, portfolio effects dominate. Watanabe & Pham (2005), also taking into consideration the dollarization phenomenon but analyze the demand for M2 domestic money and foreign currency deposits separately. Covering the period from 1993Q1 through 2004Q4, the estimated long-run equation exhibits very high income elasticity (2.76) of the demand for domestic M2. Short-term deposit rate, inflation and foreign interest rate also enter the function significantly. Meanwhile, demand for foreign currency deposits is determined by income and difference of rates of return on USD and VND deposits. Up to now, the only study which examines the stability of money demand in Vietnam is Nguyen & Pfau (2010). Employing quarterly data for 1999-2009 periods under the Johansen cointegration framework, they find evidence for a long-run relationship between real M2 demand, income, foreign interest rate and the real stock price; inflation merely intervenes in the short-run. Their CUSUM and CUSUMSQ test exhibit the stability of money demand during the sample period.

4. Empirical analysis

4.1. Function specification

Although money demand theories diverse greatly (see Sriram 1999) they share an important aspect that is the relationship between the quantity of money demanded and a set of economic variables connecting money to the real sector. The conventional and general formulation of money demand takes the form:

Equation 1 $m = f(y, r)$

where real money balances m depends on a measure of transactions or scale variable y and the opportunity cost of holding money r. Hence, the function specification involves the choice of parameters representing these three variables.

In this study, M2 money stock is firstly chosen since the central bank of Vietnam sets the annual growth rate of M2 as an intermediate target to reach its monetary policy goal. Given the weight of foreign currency deposits (FCD) in M2[8] and the dollarization in the economy, it would be interesting to consider the purely VND-denominated components of the money stock. The money demand estimation is therefore executed on both full M2 ($m2$) and M2 without FCD ($m2d$). In addition, to widening the scope of the study, M1 ($m1$) demand is also investigated. In developing countries, narrow money aggregates often show more stability and also high degree of monetary policy relevance.

For Vietnam, the most prominent candidate for the scale variable is GDP (y), because this is the only available parameter of quarterly frequency, and it could present both the income and wealth criteria that a scale variable should contain[9]. The consumer price index (CPI) representing the national price level (P) is used to derive real variables of the money stocks and GDP.

Concerning the opportunity cost of holding money, it is often said that both the own rate of money and the rate of return on alternative assets should be included in the money demand estimation (Klein 1974; Tobin 1956). The VND short-term deposit interest rate (i) is chosen to serve as the own rate of money for M2 which also comprises time and savings deposits; however, i enters M1 demand function as an opportunity cost. With reference to the rate of return on alternative assets, several variables can be appointed. Firstly, the use of expected rate of inflation (π) in the estimation is necessary (Friedman 1956 & 1969) since it can be considered as penalty for holding cash rather than switching to other assets in an inflationist economy like Vietnam. Moreover, as the financial sector is not well developed, alternative financial assets are not abundant, inducing people to look for real assets instead when high inflation occurs.

Secondly, even though the financial development in Vietnam is only at the very beginning stage, it has been growing fast these recent years. It is thus important that a proxy for financial innovations[10] enters the function, such as the stock market index ($vnse$).

Thirdly, in the presence of dollarization in Vietnam, which implies the portfolio shifts between VND and USD, the bilateral exchange rate (e) is worth taken into account with the increase of e meaning the depreciation of domestic currency[11]. The USD/VND exchange rate that the Central bank has paid much attention on[12] is preferred to the multilateral one. Besides, as domestic residents mostly stay and spend at home, ignoring any changes in the foreign price level; nominal

[8] The proportion of foreign currency deposits in M2 has gradually diminished but remains over 15%, in which the USD denominated deposits predominate.

[9] Consequently, the effect of real income on money demand in this framework can be referred to as wealth effect.

[10] Financial innovation refers both to technological advances which facilitate access to information, trading and means of payment, and to the emergence of new financial instruments and services, new forms of organization and more developed and complete financial markets.

[11] Mundell (1963) suggested the potential importance of exchange rate on money demand

[12] see Section 2

exchange rate is favoured. Another proxy for international, economic openness impact on money demand is foreign interest rate which is nevertheless less relevant here due to existing capital controls in the country. It is thus excluded in this research.

Last but not least, the incorporation of domestic gold price (*gold*) in the estimation is meaningful. Gold is highly appreciated by Vietnamese and has for long been kept as a store of value. The fact that people always keep track of gold price closely along with easy exchange of gold results in a dynamic market of this asset in Vietnam. The domestic gold price is utilized instead of the world one because it is the former that people focus on and there have been recurrent deviations between the two prices. As far as we know, it is the first time this variable in introduced in the equation of money demand. One can of course think of many other commodities which can be considered as substitutes for money like housing or land price but for Vietnam, there is no or very limited data covering these asset prices. This can however be some promising ingredients for future studies.

The money demand function can as a result be represented as follows:

Equation 2 $m = f(y, i, \pi, vnse, e, gold)$

Based on conventional economic theory, the income elasticity is expected to be positive and close to one, but for developing countries, it can be bigger as often found in researches. Because short-term deposits are included in M2 but not in M1, the interest rate semi-elasticity is supposed to be positive in the equation of broader money and negative in the other. Expected inflation is predicted to have negative relation with money demand.

Three remaining variable, for their part, could have mixed impact on money demand. Beside their obvious substitution effect on the demand for money, they can on the other hand raise the portfolio value of the asset holder, subsequently increasing the money demand through wealth effect[13]. Their elasticity thus bears undetermined sign. If the wealth effect prevails, the coefficients would be positive; otherwise they are predicted to be negative. Exchange rate substitution impact on M2 is more complex that needs to be paid particular attention. A depreciation of VND could lead the inhabitants to hold less of domestic money but more of foreign currency. In case they keep foreign currency in cash, both demand for M2 with and without FCD will decrease; else they put this extra accumulation in banks as deposits, only M2 without FCD declines but full M2 augments. For the case of Vietnam, the first situation is more likely to happen for people is more familiar with keeping foreign currency as well as other stores of value at home, and the rate of return of such deposits are less attractive in addition. That is why the overall substitution effect of exchange rate change elasticity is suggested to be negative on both of the two measures of M2.

4.2. Estimation methodology

As mentioned in section 2, the cointegration framework proposed by Pesaran et al.(2001) has gained growing confidence of empirical researchers on its validity. The advantage of this approach is its applicability not only on regressors irrespective of whether they are stationary or integrated

of order 1 but also on small-sized sample. Given these features, the bounds testing procedure is selected to identify the determinants of money demand in Vietnam; after that, the stability tests are adopted to see if the demand for money remains stable over time.

The underlying ARDL model of this approach embodies the dependent variable in its first-difference form as a function of its own lags, current and lagged changes of explanatory variables, and a linear combination of dependent and explanatory lagged level variables as in Equation 3.

Equation 3 $$\Delta m_t = c_0 + c_1 t + \alpha m_{t-1} + \theta X_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta m_{t-i} + \sum_{i=0}^{q-1} \varphi_i \Delta X_{t-i} + u_t$$

where m_t is real M2 balances, X_t is a vector of explanatory variables susceptible to explain the demand for money as listed above, t is a time trend and u_t denotes the disturbances assumed to be serially uncorrelated and normally distributed.

The bounds testing proceeds in several steps but does not require a pre-test for the presence of unit roots in variables. The aim of the first step is testing for the existence of a long-run relation between dependent variable and its predictors. In this stage, by estimating Equation 1 with the same lag length on all variables, i.e. $p = q$, the model with optimal number of lags is pointed out based on information criteria such as Akaike's (AIC) and Schwarz's Bayesian (BIC) ones, which in parallel must satisfy the non-serial correlation condition. Once we have the selection result, the Wald test for joint significance is employed on all lagged level variables of the accepted model. This test is for the null hypothesis of no cointegration or no long-run relationship defined by $H_0 : \alpha = \theta = 0$ against its alternative $H_1 : \alpha \neq 0, \theta \neq 0$. The *F*-statistic computed from this test is then compared to the critical values tabulated and presented in Pesaran et al.(2001). If it is higher than the appropriate upper bound of the critical value, the null hypothesis is rejected, meaning the long-run relationship between m_t and X_t exists; if it falls below the lower bound, H_0 cannot be rejected, and if it lies within these two bounds, the result is inconclusive. In case H_0 is rejected, Pesaran et al. (2001) suggest a supplementary test to ascertain the presence of the long-run relation – test the $H_0 : \alpha = 0$ based on the *t*-statistic t_α. By comparing t_α to critical values introduced in the paper, if this null hypothesis is rejected, a large value of t_α would help confirm the long-term relationship.

When the results of the first step, especially the *F*-stat, support the evidence of the cointegration between variables, the second step is carried out to estimate the coefficients of the long-run relationship. As indicated in Pesaran et al. (2001), the lag length for each variable need not be identical except for the identification purpose above. To this end, by letting p and q diverse, the order of the ARDL(p , q) is determined based on information criteria. The estimated Equation 3 provides the estimates of α and θ which constitute the long-run equation and allow us to get $\hat{\varepsilon}_t$ which is the equilibrium correction term.

[13] An appreciation of foreign currency vis-à-vis the domestic one would augment the portfolio value of the foreign money holder, leading to higher demand for VND via wealth effect. (Arango and Nadiri 1981).

Equation 4 $$m_t = (-1)\frac{\hat{c}_0}{\hat{\alpha}} + (-1)\frac{\hat{c}_1}{\hat{\alpha}} t + (-1)\frac{\hat{\theta}}{\hat{\alpha}} X_t + \hat{\varepsilon}_t$$

Finally, to obtain the estimated short-run coefficients, the conditional error-correction model regression associated with Equation 4 above is performed.

Equation 5 $$\Delta m_t = \eta \hat{\varepsilon}_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta m_{t-i} + \sum_{i=0}^{q-1} \varphi_i \Delta X_{t-i} + u_t$$

where $\hat{\eta}$ is the equilibrium adjustment coefficient.

The existence of cointegration relation of money demand and its determinants is not sufficient to conclude that the demand for money is stable, as Bahmani-Oskooee & Rehman (2005) pointed out. Consequently, a specific test for stability should be used. So as to examine the stability of the money demand, the tests proposed by Brown et al. (1975) named CUSUM and CUSUM squared tests are applied recursively to the residuals $\hat{u}_t$ of Equation 5.

4.3. Estimation sample data

The estimation sample is from 1999Q2 to 2011Q3, for a total of 50 quarterly observations. The sample cannot be extended due to limited data availability. The monetary and interest rate data are from International Financial Statistics (IFS) published by the IMF. Data on GDP, CPI, Vietnam stock market index (VN-Index) and VND/USD exchange rate are extracted from Reuter's database. Real GDP and inflation expectation variables are deseasonalized for they exhibit seasonal factors. The stock market had not been inaugurated until July 2000, so the VN-Index of end-July 2000 is appended to 2000Q2 observation while each of the first four points is given a value of 100. We are allowed to do so because the market scale was quite small at that time. The Vietnam gold price is taken from the SBV source. The expected rate of inflation is calculated based on Gerlach and Svensson's formulation of rational expectations (ADDIN ZOTERO_ITEM CSL_CITATION {"citationID":"E3hpFpDb","properties":{"formattedCitation":"(Gerlach and Svensson 2003)","plainCitation":"(Gerlach and Svensson 2003)"},"citationItems":[{"id":124,"uris":["http://zotero.org/users/447860/items/7TMG4VMA"],"uri":["http://zotero.org/users/447860/items/7TMG4VMA"],"itemData":{"id":124,"type":"article-journal","title":"Money and inflation in the euro area: A case for monetary indicators?","container-title":"Journal of Monetary Economics","page":"1649-1672","volume":"50","issue":"8","source":"ScienceDirect","abstract":"This paper examines inflation indicators for the euro area by studying the relationship between inflation, output, money and interest rates, using data spanning 1980–2001. The central finding is that both the output gap and the real money gap (the difference between the real money stock and the long-run equilibrium real money stock) contain considerable information regarding future inflation. In contrast, the Eurosystem's money-growth indicator (the difference between nominal money growth and a reference value), the prominent "first pillar" in its monetary strategy, contains little information about future inflation, and no information beyond that contained in the output and real money gaps. The predictive performance of the output gap has improved compared to that in a previous

version of this paper, most likely because of better estimation methods.","DOI":"10.1016/j.jmoneco.2003.02.002","ISSN":"0304-3932","shortTitle":"Money and inflation in the euro area","author":[{"family":"Gerlach","given":"Stefan"},{"family":"Svensson","given":"Lars E.O"}],"issued":{"date-parts":[["2003",11]]},"accessed":{"date-parts":[[2012,6,13]]}}],"schema":"https://github.com/citation-style-language/schema/raw/master/csl-citation.json"} (Gerlach and Svensson 2003))[14]. A summary of variable definition as well as a statistical description of the data is demonstrated in Table 7 and Table 8 in the Appendix 1. All variables are in logarithm form, except interest rate and inflation.

4.4. Results

Although it is not required by the bounds testing procedure that stationary tests are driven, it is important to ensure that none of the variables are integrated of order higher than one. We thus begin by testing for the presence of unit roots in the variables. The Augmented Dickey-Fuller (ADF) unit root test is run on both level and first-difference variables, with the lag length determined by Schwarz's Bayesian information criterion. A constant is included in all models and the regressions are done with or without a time trend.

The results presented in Table 1 show that we cannot reject the null hypothesis of existence of a unit root in a half of level variables at 5% significance level. Money demand (all three aggregates), inflation and interest rate are trend stationary. On the other hand, all variables are I(1), irrespective of whether a linear time trend exists in the series. Our dataset thus comprehends a mixture of I(0) and I(1) processes, which guaranties the suitability of the ARDL approach and confirms our methodology choice.

[Insert Table 1 about here]

Entering the first step of the bounds testing procedure, the existence of a long-run relation between money demand and its predictors is investigated. Since the interest rate failed to supply statistically significant parameter estimates in the demand function of all money balances, the model reported for M2 and M2D henceforth are composed of five variables as money demand determinants that are real income, expected inflation, stock market index, nominal exchange rate and gold price. Moreover, the stock market index empirically appears to be an insignificant explanatory of M1 demand, inducing us to re-estimate the equation without this variable. As a result, four explanatory variables in the M1 demand function are real income, expected inflation, nominal exchange rate and gold price.

Based on preconditions of the bounds testing procedure, only models without serial correlation problem should be considered. As can be seen in Table 2[15], the model which satisfies this requisite and has minimal AIC and BIC value for M1 is the one with four lags of the regressors, and three

[14] A description of the calculation is exhibited in the Appendix 2.
[15] The lag order of variables is restricted to 4 lags to avoid multicollinearity problem in the estimations.

lags for both M2 and M2D. Besides, the M1 three-lag model and one-lag model of M2 and M2D can be chosen for further investigation because they are supported by no serial correlation test result.

[Insert Table 2 about here]

The *F*-test and *t*-test are then carried out on these models with or without a trend. The *F*-statistics of M1 models gives mixed results concerning the lag choice: while it supports three-lag model without trend, it also does in the case of model with four lags and trend (Table 3). The *t*-statistics do not help us to choose the final model between these two because the results both fall below the lower bound of 0.05 critical values. However, this is not a critical point since evidences of the presence of long-run relationship between M1 demand and its determinants are found.

For M2 and M2D, the *F*-test results are unanimous. The existence of a long-run relationship is discovered in the three-lag models no matter a trend is incorporated or not. Therefore, at the end of this stage, we can conclude that the null hypothesis of no long-run equation for money demand, irrespective of monetary aggregates, is rejected. The function estimation can now be processed.

[Insert Table 3 about here]

By searching among $4^4 = 256$ equations for M1, and the same number of equations of $4^5 = 1024$ for both M2 and M2D, using AIC and BIC as guides, the following ARDL models are selected for each of the three money balance. The ARDL(3,1,3,1,3) is chosen for M1 where the corresponding lags for money, income, inflation, exchange rate and gold price are shown in the parenthesis respectively. For M2 and M2D, we have the ARDL(3,1,4,1,3,0) and ARDL(2,1,3,1,3,1) with the last number in the parenthesis denotes the stock price variable lag order, other things being equal.

These specifications result in the estimated long-run money demand manifested in Equation 6, Equation 7 and Equation 8. All parameter estimates have the expected sign and are statistically significant at 5% at least.

Equation 6

$$\underset{}{m1_t} = \underset{(0.302)}{1.552\, y_t} - \underset{(0.003)}{0.021\, \pi_t} - \underset{(0.354)}{3.102\, e_t} + \underset{(0.101)}{0.595\, gold_t} - \underset{(1.468)}{2.115} + \hat{\varepsilon}_t$$

Note: Standard errors are given in brackets. Source: Author's estimates

Equation 7

$$\underset{}{m2_t} = \underset{(0.165)}{1.638\, y_t} - \underset{(0.002)}{0.024\, \pi_t} - \underset{(0.222)}{4.932\, e_t} + \underset{(0.061)}{1.271\, gold_t} - \underset{(0.014)}{0.095 vnse_t} - \underset{(0.785)}{2.337} + \hat{\varepsilon}_t$$

Note: Standard errors are given in brackets. Source: Author's estimates

Equation 8

$$\underset{}{m2d_t} = \underset{(0.159)}{1.612\, y_t} - \underset{(0.003)}{0.028\, \pi_t} - \underset{(0.283)}{6.013\, e_t} + \underset{(0.078)}{1.635\, gold_t} - \underset{(0.017)}{0.170 vnse_t} - \underset{(0.855)}{2.235} + \hat{\varepsilon}_t$$

Note: Standard errors are given in brackets. Source: Author's estimates

The income elasticity in three money demand functions is all greater than one, but close to one another. From M1, passing by M2D, to full M2, we can observe that the broader the considered money stock, the higher the estimated elasticity. Referring to existing literature on money demand, the same statement can be found in general(Knell & Stix (2004)). This result itself is reasonable, because narrow money is basically held for transaction purposes while there is also a role for portfolio motives in broad money.

The highest value of 1.64 is registered for M2, smaller than previous results for Vietnam as in Watanabe & Pham (2005) and Nguyen & Pfau (2010) which are 2.76 and 2.52 respectively. The origin of these differences may emerge from the omission of wealth measures in money demand estimation in these studies. Knell & Stix (2004) argue that given high correlation between income and wealth, the lack of such variables will lead to overestimation of the income elasticity. On the other hand, our estimated coefficient is in accordance with findings of money demand studies for other developing countries like Bahmani-Oskooee & Wang (2007) on China, Dritsakis (2011) on Hungary, Dagher & Kovanen (2011) on Ghana, etc.

Expected inflation can surprisingly produce only small effect on money demand. This would be due to the fact that people have been familiar with high inflation which causes some degree of indifference against the phenomenon.

The estimated exchange rate substitution impact on all three measures of money demand is of critical importance, going from 3.1 to 6 percent reduction of the demand on VND following a depreciation of one percent of the domestic currency. The response of M2 without FCD to a rise in e is particularly vigorous, more than one-point greater than that of full M2. This could reflect the fact that a small proportion of the extra foreign currency held by Vietnamese is put in banks as deposits beside a larger part kept in cash as their well-known preference. A dong depreciation will reduce the quantity demanded for domestic money, decreasing M2 and M2D, but in the same time increase the FCD component of M2. The net effect is a diminution for both M2 and M2D since a major portion of foreign currency is held in cash.

The estimate of the gold price elasticity shows that the money demand, irrespective of measures, and the domestic price of gold move in the same direction. One percent increase in the gold price will cause a 0.6 percent augmentation in the M1, 1.3 percent in M2 and 1.6 percent in M2D demand in the long run. The positive sign means that holders of gold benefit from its incremental price (wealth effect) rather than reform their portfolio after such changes. The magnitude is relatively important, which is imaginable for a country like Vietnam with an impressively dynamic market for gold. This considerable influence of gold price confirms the argument presented above of Knell & Stix (2004). Indeed, the inclusion of wealth aspect of gold in the money demand function helps obtain better estimations of income elasticity.

Finally, stock price provides statistically significant estimates in both M2 and M2D equation. Securities appear to be a promising alternative asset for domestic investors even though the effective impact of the stock market is still minor.

[Insert Table 4, Table 5 and Table 6 about here]

The results of the conditional ECM regressions are given in Table 4, Table 5 and Table 6. These estimates provide some complementary information on the complex dynamics existing between money demand and its determinants. The general observation is that the behaviour of regressors is mostly the same in all three money demand function. The statistics are highly significant. The regressions fit very well as they pass all the diagnostic tests against non-normal errors, heteroscedasticity, serial correlation of the residuals and functional form misspecification. A more detailed investigation is provided below.

Firstly, the error-correction term is largest for M1, implying that a half of a movement of real M1 demand away from its long-run equilibrium will be adjusted in the coming quarter. For M2 and M2D, the adjustment speed is a bit lower, ranging from –0.31 to –0.34. Hence, it would take nearly three quarters to absorb all the eventual misalignment in M2 and M2D demand. These results suggest that deviations from the equilibrium are rather short-lived no matter narrow or broad money is considered. Comparable findings can be found in Baharumshah et al. (2009) and Bahmani-Oskooee & Wang (2007) on China and Kumar (2011) on some other Asian and African developing countries.

Money own short-run impact is overall corrective for M1 but also presents some stimulating effect for M2 and M2D demand dynamics. Income elasticity is relatively large, especially for M2 and M2D, indicating important income effect on money demand, even in the short run.

Expected inflation effect in the short run is similar to that in the long-run and of the same magnitude regarding the three monetary aggregates: one percent increase in inflation anticipated by the residents will lead to a one-tenth percent variation in the money demand. However, in the short-run, apart from its instantaneous substitution effect, inflation also exhibits some promoting impact on money demand. Its parameters become positive in the ECM, meaning that people increase their demand for domestic money if they anticipate a short-term surge of inflation. This can be explained by the fact that in the short-run, lack of time to adjust their portfolio, people choose to hold more money to deal with domestic inflated goods, leading to an upward trend in demand for cash balances.

While exchange rate substitution effect is maintained in the short run for every money stock measure, negative parameters of gold price demonstrate a prevailing substitution instead of wealth effect in the near future. The compounded effect over three quarters of this variable of at least –1.3 (in case of $m2d$) manifests its meaningful contribution to the explication of the money demand in Vietnam, which has however been omitted in all existing empirical researches. The stock price variable also follows gold price performance. It adjusts the demand for real money balances via wealth effect in the short run, against long-run substitution effect; however, its influence remains small.

The last step which consists of examining the stability of the estimated long-run relationship between money demand and its determinants is now carried out. Stability of each of the three relations is examined using the CUSUM and CUSUM squared tests. The plots of these tests are presented in Figure 1, Figure 2 and Figure 3. The figures show that M1 and M2D are stable from

1999 to 2011 since the test statistics remain within their critical value at 5% significant level over the whole sample period. Nonetheless, M2 exhibits some instability during two years from the beginning of 2006 to the end of 2008. This pre-crisis period is characterized not only by high economic growth but also particularly by high money and credit growth in Vietnam. Excessive credit and money supply should be the major driven factor of such instability of the M2 demand. Although M2 is unstable solely temporarily, this event should be carefully taken into account by the central bank if it wishes to continue its actual monetary policy strategy.

5. Conclusion

Understanding the demand for money is crucial for an effective implementation of monetary policy. However, there have merely been a handful of empirical researches on this topic for Vietnam. Wishing to enrich the money demand literature for the country, this study is performed to investigate the stability of money demand in Vietnam, not only on M2 as usually seen but also on M1 and M2 without foreign currency deposits. Additionally, since the latest work published its results, there have been many global and country-specific significant events likely to influence the money demand. They need to be taken into consideration when conducting such a study.

Using the recent cointegration framework developed by Pesaran et al. (2001), we find evidences for a long-run relationship between money demand, regardless of which monetary aggregate is considered, and income, expected inflation, exchange rate and gold price. M2 and M2D demand are also determined by movements in stock price. Income elasticities are close to 1.5, which is appropriate with the actual state of development of Vietnam and comparable to the findings of studies on other developing countries. Exchange rate is found to be the most important variable to determine the demand for money, which is compatible with the considerable level of dollarization in the nation. Recurrently high inflation and arising stock market contributes to the significance of expected inflation in all three measures of money and stock price index in the M2 demand equation. The gold price variable, which is introduced in the money demand equation for the first time, expresses its strong relevance. This result can inspire future practical works for countries where this precious metal has a substantial place in the economy. The failure of deposit interest rate to present significant impact on real money balances can be accounted for by the fact that under high inflation, deposit interest rates offered by banks are not sufficient to prevail over the inflation rate, provoking people's indifference on this financial parameter. Moreover, Le & Pfau (2009) on monetary transmission channels in Vietnam find that the interest rate channel plays only a little role in transmitting the monetary policy.

The estimation of the error-correction model associated with the long-run equation indicates that the mean reversion speed is relatively high. It only takes two quarters for M1 and more than three for M2 and M2D to converge back to the long-run equilibrium after experiencing any imbalance caused by previous periodical shocks. The results of the ECM also point out the complexity of the relation between money demand and its explanatory variables. Income and exchange rate important role found in long-run money demand function should be a continuation from their short-run impact. Meanwhile expected inflation and gold price manifest some contrasting effect in

the short run. The positive signs of inflation short-term estimates show that people ask for more money in the nearer future to deal with higher prices rather than to switch their portfolio. Gold price has for its part a predominant wealth effect. With regard to the stock exchange, it provides some relatively small wealth effect, reflecting the reality that securities have remained marginal alternative assets for Vietnamese.

These findings on the one hand are consistent with the present conduct of monetary policy of the State Bank of Vietnam in some aspects as it has taken into account inflation rate, exchange rate and gold price. For instance, the central bank has recently adopted the new mandate of stabilizing the value of dong expressed by the inflation rate defined by the Law on the State Bank of 2010, which took effect January 1st 2011. It also intervened onto the domestic gold market in order to calm this market down in 2011. On the other hand, our results could be useful for the future monetary policy. The SBV had better rely less on interest rate instruments to make its policy more responsive. Moreover, it is imperative that the Vietnam's macroeconomic conditions be improved to regain residents' confidence on the domestic money as foreign currency and gold holdings would provoke a powerful substitution effect against the Vietnam dong which destabilizes the economy even more. Additionally, the Bank should also reinforce then improve its credibility in order to better anchor residents' inflation expectations to its objective, ameliorating the monetary policy efficiency.

Finally, the stability test result can only conclude the stable nature of M1 and M2D demand. It fails on the other hand to approve the stability of the demand for M2 during 2006-2008 period. Even though M2 demand managed to return to the equilibrium afterwards, the SBV should seriously revisit its policy. Given M2 being one of its intermediate targets, the lack of stability of M2 demand should lead to a modification or even an abandon of the actual monetary targeting strategy.

Reference

Achsani, Noer Asam. 2010. "Stability of Money Demand in an Emerging Market Economy: An Error-correction Model and ARDL Model for Indonesia." *Research Journal of International Studies* (13): 83–91.

Adam, Christopher, Michael Goujon, and Sylviane Guillaumont-Jeanneney. 2004. "The Transactions Demand for Money in the Presence of Currency Substitution: Evidence from Vietnam." *Applied Economics* (36): 1461–1470.

Akinlo, A. Enisan. 2006. "The Stability of Money Demand in Nigeria: An Autoregressive Distributed Lag Approach." *Journal of Policy Modeling* 28 (4): 445–452. doi:10.1016/j.jpolmod.2005.09.001.

Arango, Sebastian, and M. Ishaq Nadiri. 1981. "Demand for Money in Open Economies." *Journal of Monetary Economics* 7 (1): 69–83. doi:10.1016/0304-3932(81)90052-0.

Azim, Dr. Parvez, Dr. Nisar Ahmed, Sami Ullah, Bedi-uz Zaman, and Muhammad Zakaria. 2010. "Demand for Money in Pakistan: An Ardle Approach." *Global Journal of Management And Business Research* 10 (9) (December 23).

Baharumshah, Ahmad Zubaidi, Siti Hamizah Mohd, and Mansur M. Masih. 2009. "The Stability of Money Demand in China: Evidence from the ARDL Model." *Economics Systems* (33): 231–244.

Bahmani-Oskooee, Mohsen. 2001. "How Stable Is M2 Money Demand Function in Japan?" *Japan and the World Economy* 13 (4): 455–461. doi:10.1016/S0922-1425(01)00064-0.

Bahmani-Oskooee, Mohsen, and Hafez Rehman. 2005. "Stability of the Money Demand Function in Asian Developing Countries." *Applied Economics* 37 (7): 773–792.

Bahmani-Oskooee, Mohsen, and Yongqing Wang. 2007. "How Stable Is the Demand for Money in China?" *Journal of Economic Development* 32 (1) (June): 21–33.

Brown, R. L., J. Durbin, and J. M. Evans. 1975. "Techniques for Testing the Constancy of Regression Relationships over Time." *Journal of the Royal Statistical Society. Series B (Methodological)* 37 (2) (January 1): 149–192.

Dagher, Jihad, and Arto Kovanen. 2011. "On the Stability of Money Demand in Ghana: A Bounds Testing Approach." *IMF Working Papers* (WP/11/273) (November).

Dahmardeh, Nazar, and Hamid Reza Izadi. 2011. "Demand for Money in Iran by an Autoregressive Distributed Lag Approach." *Middle-East Journal of Scientific Research* 9 (5): 687–690.

Dritsakis, Nikolaos. 2011. "Demand for Money in Hungary: An ARDL Approach." *Review of Economics & Finance* (06/2011) (June).

Engle, Robert F., and C. W. J. Granger. 1987. "Co-Integration and Error Correction: Representation, Estimation, and Testing." *Econometrica* 55 (2) (March 1): 251–276. doi:10.2307/1913236.

Friedman, Milton. 1956. "The Quantity Theory of Money - A Restatement." In *Studies in the Quantity Theory of Money*, M. Friedman. Chicago, USA: University of Chicago Press.

———. 1969. "The Optimum Quantity of Money." In *The Optimum Quantity of Money and Other Essays*, M. Friedman. Chicago, USA: Aldine Publishing Company.

Gerlach, Stefan, and Lars E.O Svensson. 2003. "Money and Inflation in the Euro Area: A Case for Monetary Indicators?" *Journal of Monetary Economics* 50 (8) (November): 1649–1672. doi:10.1016/j.jmoneco.2003.02.002.

IMF. 2010. "Staff Country Report - Vietnam 2010". 10/281.

Johansen, Soren, and Katarina Juselius. 1990. "Maximum Likelihood Estimation and Inference on Coitegration - with Applications to the Demand for Money." *Oxford Bulletin of Economics and Statistics* 52 (2): 169–210.

Klein, Benjamin. 1974. "Competitive Interest Payments on Bank Deposits and the Long-Run Demand for Money." *American Economic Review* 64 (6): 931–49.

Knell, Markus, and Helmut Stix. 2004. "Three Decades of Money Demand Studies. Some Differences and Remarkable Similarities." *Oesterreichische Nationalbank Working Papers* (88) (June).

Kumar, Saten. 2011. "Financial Reforms and Money Demand: Evidence from 20 Developing Countries." *Economics Systems* (35): 323–334.

Le, Viet Hung, and Wade D. Pfau. 2009. "VAR Analysis of the Monetary Transmission Mechanism in Vietnam." *Applied Econometrics and International Development* 9 (1) (June): 165–179.

Leung, Suiwah. 2009. "Banking and Financial Sector Reforms in Vietnam." *ASEAN Economic Bulletin* 26 (1) (April): 44–57.

Mundell, Robert A. 1963. "Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates." *The Canadian Journal of Economics and Political Science / Revue Canadienne d'Economique Et De Science Politique* 29 (4) (November): 475–485.

Narayan, Paresh Kumar, and Russell Smyth. 2006. "Higher Education, Real Income and Real Investment in China: Evidence From Granger Causality Tests." *Education Economics* 14 (1): 107–125. doi:10.1080/09645290500481931.

Narayan, Seema, and Paresh Kumar Narayan. 2005. "An Empirical Analysis of Fiji's Import Demand Function." *Journal of Economic Studies* 32 (2) (January 4): 158–168. doi:10.1108/01443580510600931.

Nguyen, Huyen Diu, and Wade D. Pfau. 2010. "The Determinants and Stability of Real Money Demand in Vietnam, 1999-2009." *GRIPS Policy Research Center Discussion Paper* (10-14).

Padhan, Purna Chandra. 2011. "Stability of Demand for Money in India: Evidence from Monetary and Liquidity Aggregates." *International Journal of Economics and Finance* 3 (1) (November 1): 271. doi:10.5539/ijef.v3n1p271.

Pesaran, M. Hashem, Yongcheol Shin, and Richard J Smith. 2001. "Bounds Testing Approaches to the Analysis of Level Relationships." *Journal of Applied Econometrics* 16 (3) (May 1): 289–326. doi:10.1002/jae.616.

Samreth, Sovannroeun. 2009. "Estimating Money Demand Function in Cambodia: ARDL Approach." *MPRA Paper* (16274). Online at Http://mpra.ub.uni-muenchen.de/16274/ (July).

Sriram, Subramanian S. 1999. "Survey of Literature on Demand for Money: Theoretical and Empirical Work with Special Reference to Error-Correction Models." *IMF Working Papers* (WP/99/64) (May).

Tang, Chor Foon. 2007. "The Stability of Money Demand Function in Japan: Evidence from Rolling Cointegration Approach." *MPRA Paper* (19807).

Tobin, James. 1956. "Liquidity Preference as Behavior Towards Risk." *The Review of Economics and Statistics* 38 (3) (August): 241–247.

Watanabe, Shinichi, and Thai Binh Pham. 2005. "Demand for Money in Dollarized, Transitional Economy: The Case of Vietnam." In Tokyo, Japan.

Table 1 ADF unit root test

Variable	Level		First difference	
	(1)	(2)	(1)	(2)
*m*1	0.198	0.043	0.000	0.000
*m*2	0.172	0.041	0.001	0.004
*m*2*d*	0.159	0.034	0.000	0.000
y	0.839	0.074	0.000	0.001
π	0.543	0.000	0.003	0.001
i	0.808	0.000	0.000	0.003
vnse	0.257	0.420	0.000	0.002
e	0.998	0.996	0.004	0.021
gold	0.999	0.603	0.000	0.001

Models contain an intercept and (1) no deterministic trend or (2) a deterministic trend

Statistics presented are p-value of the ADF tests

Source: Author's estimates

Table 2 Statistics for selecting the lag order

M1								
Lag	Without deterministic trend				With deterministic trend			
	AIC	BIC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$	AIC	BIC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$
1	-97.06	-69.31	6.53	20.84	-110.56	-80.96	2.92*	17.10
2	-130.55	-93.98	0.90*	12.04	-130.17	-91.77	0.05*	11.62
3	-150.07	-104.90	0.01*	6.86*	-148.90	-101.93	0.00*	6.05*
4	-159.97	-106.45	0.10*	1.26*	-167.78	-112.47	2.72*	5.96*

M2								
Lag	Without deterministic trend				With deterministic trend			
	AIC	BIC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$	AIC	BIC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$
1	-176.01	-142.70	1.33*	3.47*	-185.11	-149.96	0.15*	0.82*
2	-242.97	-199.08	3.96	8.82*	-247.06	-201.34	3.81*	10.53
3	-245.20	-191.00	0.08*	5.00*	-252.70	-196.70	0.25*	8.38*
4	-266.76	-202.53	8.08	69.07	-271.95	-205.93	8.12	45.23

M2D								
Lag	Without deterministic trend				With deterministic trend			
	AIC	BIC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$	AIC	BIC	$\chi^2_{SC}(1)$	$\chi^2_{SC}(4)$
1	-158.39	-125.09	0.20*	3.90*	-169.07	-133.92	0.33*	2.92*
2	-221.88	-177.99	5.45	6.54*	-224.98	-179.26	5.17	6.69*
3	-224.19	-169.99	0.04*	1.05*	-231.54	-175.53	2.42*	6.12*
4	-238.74	-174.51	1.21*	31.14	-255.66	-189.64	2.87*	31.53

Notes: AIC and BIC are Akaike's and Schwarz's Bayesian Information Criteria. $\chi^2_{SC}(1)$ and $\chi^2_{SC}(4)$ are chi-squared statistics to test for no residual serial correlation of order 1 and 4 respectively. * refers to the acceptance of H_0 at 5% significance level. Source: Author's estimates

Table 3 *F*- and *t*-statistics for testing the existence of the long-run relationship

M1				
Lags	Without deterministic trend		With deterministic trend	
	F-stat	*t*-stat	*F*-stat	*t*-stat
3	4.59 (u)	-0.68 (l)	4.46 (b)	-0.27 (l)
4	3.86 (b)	-2.57(b)	5.11 (u)	-2.04 (l)

M2				
Lags	Without deterministic trend		With deterministic trend	
	F-stat	*t*-stat	*F*-stat	*t*-stat
1	1.39 (l)	-1.59 (l)	2.91 (l)	-3.19 (l)
3	3.90 (u)	-2.22 (l)	4.69 (u)	-2.81 (l)

M2D				
Lags	Without deterministic trend		With deterministic trend	
	F-stat	*t*-stat	*F*-stat	*t*-stat
1	1.12 (l)	-1.67 (l)	2.86 (l)	-3.44 (l)
3	4.17 (u)	-3.25 (b)	5.27 (u)	-3.31 (l)

Notes: All models contain an unrestricted intercept. (u): the statistic lies above the 0.05 upper bound; (b): the statistic falls between the 0.05 bounds; (l): the statistic lies below the 0.05 lower bound.
Source: Author's estimates

Table 4 Equilibrium Error-Correction form of the ARDL(3,1,3,1,3) for M1

Lag order	0	1	2	3	4
ECT		-0.521***			
		(0.081)			
$\Delta m1$		-0.432***	-0.309***	-0.348***	
		(0.090)	(0.111)	(0.097)	
Δy	0.792**	0.775**			
	(0.311)	(0.290)			
$\Delta \pi$	-0.014***	0.010	-0.011	0.004	
	(0.004)	(0.006)	(0.007)	(0.005)	
Δe	-1.547***	-1.569***			
	(0.456)	(0.397)			
$\Delta gold$	0.165	-0.603***	-0.631***	-0.431***	
	(0.137)	(0.138)	(0.136)	(0.150)	

$\overline{R}^2 = 0.84$; $RSS = 0.04$; Log-likelihood = 93.29 ; AIC = -152.57 ; BIC = -121.86 ;
$\chi^2_H(1) = 0.76[0.38]$; $\chi^2_N(2) = 1.31[0.52]$; $\chi^2_{SC}(4) = 7.44[0.11]$; $F_{(3;25)} = 2.15[0.11]$

Standard errors are given in parenthesis. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively. $\overline{R}^2$ is the adjusted squared multiple correlation coefficient, RSS is the residual sum of squares, AIC and BIC are Akaike's and Schwarz's Bayesian Information Criteria, $\chi^2_H(1)$, $\chi^2_N(2)$ and $\chi^2_{SC}(4)$ refer to chi-squared statistics to test for homoskedasticity, normality of the errors and no residual serial correlation respectively, and $F_{(3;25)}$ is Ramsey RESET test statistic for no functional form misspecification, p-values are given in [.]. Source: Author's estimates

Table 5 Equilibrium Error-Correction form of the ARDL(3,1,4,1,3,0) for M2

Lag order	0	1	2	3	4
ECT		-0.337***			
		(0.037)			
$\Delta m2$		-0.693***	0.178**	0.033	
		(0.096)	(0.076)	(0.081)	
Δy	1.128***	0.367***			
	(0.113)	(0.101)			
$\Delta \pi$	-0.013***	0.014***	0.001	-0.004	-0.003
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Δe	-1.262***	-0.872***			
	(0.168)	(0.138)			
$\Delta gold$	0.042	-0.447***	-0.562***	-0.356***	
	(0.045)	(0.057)	(0.058)	(0.060)	
$\Delta vnse$	0.022**				
	(0.009)				

$\overline{R}^2 = 0.92$; $RSS = 0.004$; Log-likelihood = 144.22 ; AIC = -246.44 ; BIC = -212.54 ;
$\chi^2_H(1) = 2.11[0.15]$; $\chi^2_N(2) = 2.73[0.26]$; $\chi^2_{SC}(4) = 4.80[0.31]$; $F_{(3;22)} = 0.15[0.93]$

Standard errors are given in parenthesis. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively. $\overline{R}^2$ is the adjusted squared multiple correlation coefficient, RSS is the residual sum of squares, AIC and BIC are Akaike's and Schwarz's Bayesian Information Criteria, $\chi^2_H(1)$, $\chi^2_N(2)$ and $\chi^2_{SC}(4)$ refer to chi-squared statistics to test for homoskedasticity, normality of the errors and no residual serial correlation respectively, and $F_{(3;25)}$ is Ramsey RESET test statistic for no functional form misspecification, p-values are given in [.]. Source: Author's estimates

Table 6 Equilibrium Error-Correction form of the ARDL(2,1,3,1,3,1) for M2D

Lag order	0	1	2	3	4
ECT		-0.312*** (0.036)			
$\Delta m2d$		-0.395*** (0.097)	0.045 (0.096)		
Δy	1.091*** (0.159)	0.943*** (0.127)			
$\Delta \pi$	-0.007*** (0.002)	0.012*** (0.003)	-0.001 (0.003)	0.002 (0.003)	
Δe	-2.298*** (0.249)	-1.535*** (0.216)			
$\Delta gold$	0.063 (0.065)	-0.628*** (0.080)	-0.510*** (0.072)	-0.231*** (0.231)	
$\Delta vnse$	0.002 (0.006)	0.006 (0.014)			

$\overline{R}^2 = 0.88$; $RSS = 0.009$; Log-likelihood = 128.25 ; AIC = -220.47 ; BIC = -187.95 ;
$\chi^2_H(1) = 0.85[0.36]$; $\chi^2_N(2) = 0.15[0.93]$; $\chi^2_{SC}(4) = 6.62[0.16]$; $F_{(3;24)} = 0.42[0.74]$

Standard errors are given in parenthesis. *, ** and *** denote statistical significance at 10%, 5% and 1% respectively. $\overline{R}^2$ is the adjusted squared multiple correlation coefficient, RSS is the residual sum of squares, AIC and BIC are Akaike's and Schwarz's Bayesian Information Criteria, $\chi^2_H(1)$, $\chi^2_N(2)$ and $\chi^2_{SC}(4)$ refer to chi-squared statistics to test for homoskedasticity, normality of the errors and no residual serial correlation respectively, and $F_{(3;25)}$ is Ramsey RESET test statistic for no functional form misspecification, p-values are given in [.]. Source: Author's estimates

Figure 1 CUSUM and CUSUMSQ tests for M1

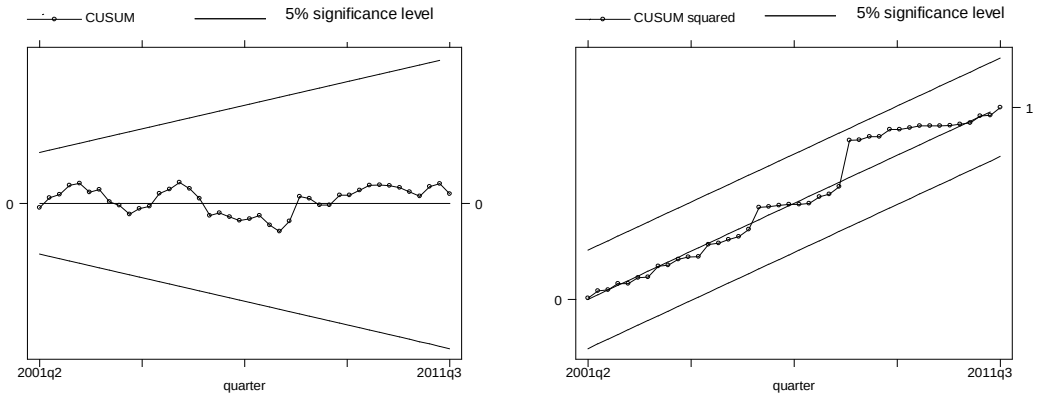


Figure 2 CUSUM and CUSUMSQ tests for M2

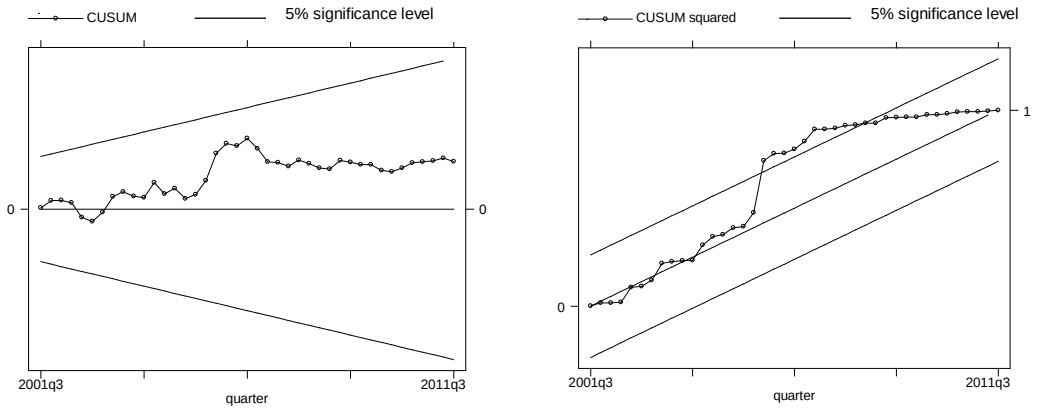
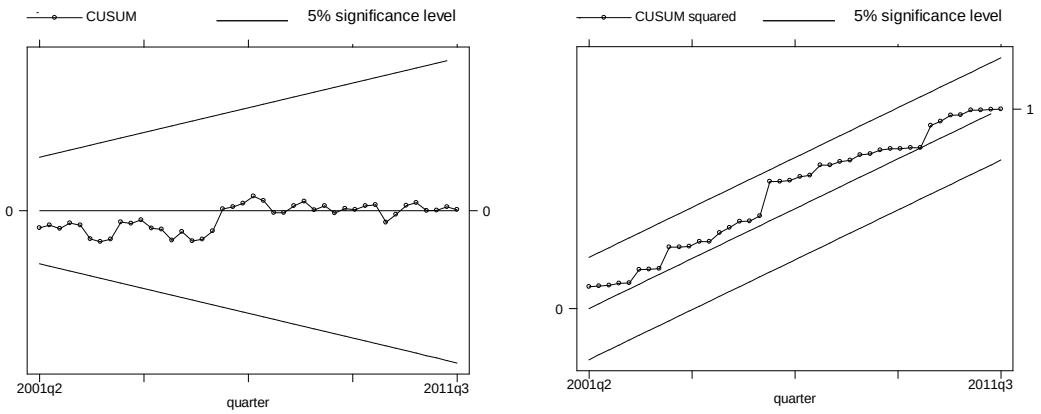


Figure 3 CUSUM and CUSUMSQ tests for M2D



Source: Author's estimates

Appendix 1

Table 7 Variable definition

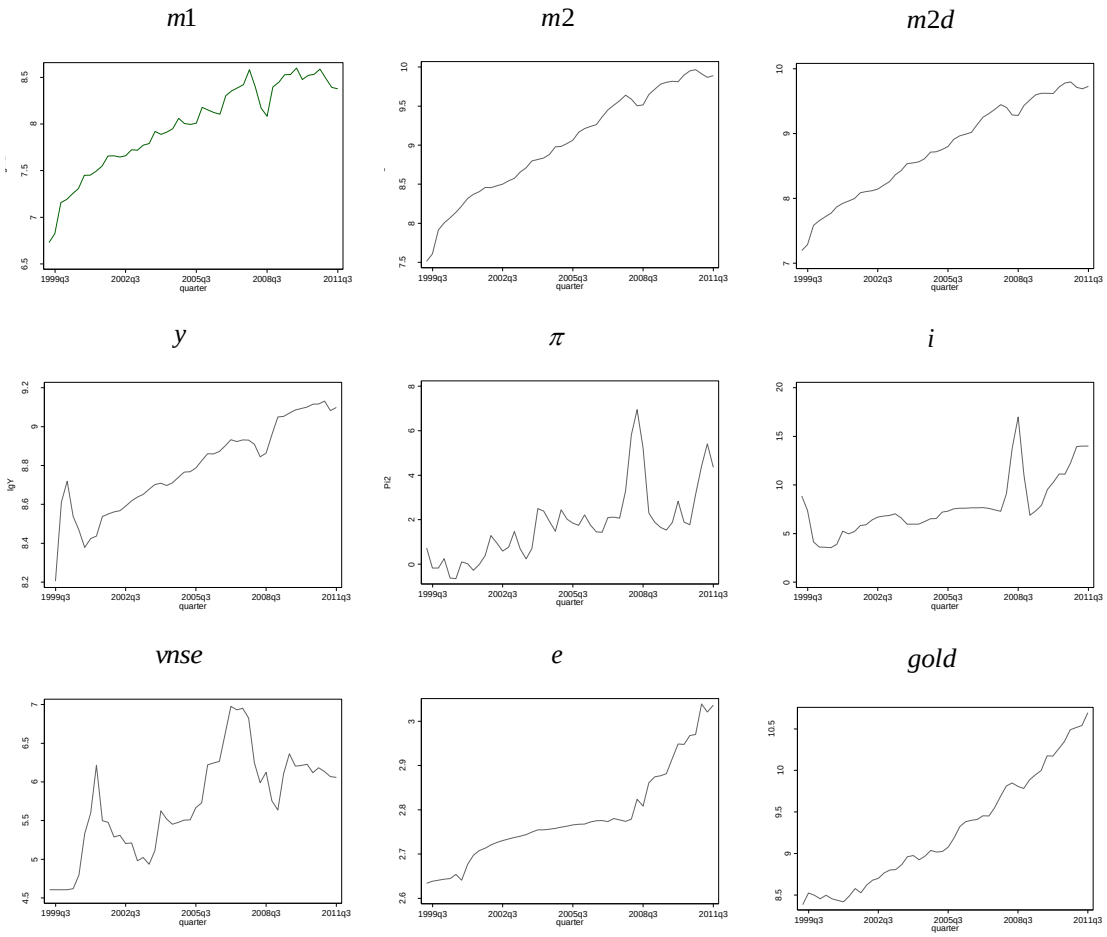
Variable	Definition
$m1$	Logarithm of Real narrow money – M1, derived by dividing M1 by P (M1 in billions of VND)
$m2$	Logarithm of Real broad money, including foreign currency deposits – M2, derived by dividing M2 by P (M2 in billions of VND)
$m2d$	Logarithm of Real broad money, without foreign currency deposits – M2D, derived by dividing M2D by P (M2D in billions of VND)
P	Consumer price index (2009=100)
y	Logarithm of Real income, derived by dividing Gross Domestic Product (GDP) by P (GDP in billions of VND)
π	Expected rate of inflation (percent)
i	Average deposit interest rate offered by banks, end of period (percent)
$vnse$	Logarithm of VN-index of the Ho Chi Minh City stock exchange, end of period (VN-index: 2000=100)
e	Logarithm of Nominal VND/USD exchange rate, end of period (exchange rate in thousands of VND per USD)
$gold$	Logarithm of Vietnam gold price, end of period (gold price in thousands of VND per tael, 1 tael ~ 1.2057oz)
Sources	- IMF International Financial Statistics (provided by Reuters Ecowin) - Reuters Ecowin Pro 6.0 - State Bank of Vietnam

Table 8 Summary statistics, 1999Q2 - 2011Q3

Variable	Mean	Standard deviation	Min.	Max.	Skewness	Kurtosis	Obs.
*m*1	7.978	0.480	6.729	8.599	-0.673	2.745	50
*m*2	9.028	0.677	7.514	9.966	-0.340	2.088	50
*m*2*d*	8.763	0.743	7.193	9.797	-0.288	1.926	50
y	8.789	0.229	8.205	9.131	-0.284	2.380	50
π	4.293	5.860	-5.770	21.455	0.963	4.299	50
i	7.831	2.983	3.540	16.990	1.118	3.961	50
vnse	5.720	0.651	4.605	6.977	-0.010	2.284	50
e	2.784	0.106	2.634	3.039	0.836	3.077	50
gold	9.273	0.683	8.386	10.694	0.463	2.010	50

Sources: IMF IFS, Reuters, SBV and Author's calculations

Figure 4 Data graphs 1999Q2-2011Q3



Sources: IMF IFS, Reuters, SBV and Author's calculations

Appendix 2

Rational inflation expectations formulation

We follow Gerlach and Svensson (2003) specification in which public's inflation expectations depend simultaneously on the central bank's implicit inflation objective, π_t^{obj}, and the credibility of this objective, as shown in Equation 9. The implicit inflation objective here can be interpreted as the inflation rate that policy makers would find appropriate when designing and implementing monetary policy, which is not necessarily a formal target disclosed to the public.

Equation 9 $$\pi_{t+4,t}^{e} = \pi_{t+4}^{obj} + \alpha_{\pi}(\pi_t - \pi_t^{obj})$$

where $\pi_{t+4,t}^{e}$ is the four-quarter expected inflation rate at *t*+4 based on information at *t*, π_t is the four-quarter change in the consumer price index at *t*, i.e. the effective annualized quarterly inflation rate at *t*[16].

This modeling allows us not only capture the persistence of past inflation rates in the expectation formulation but also incorporate information for the assessment of monetary policy credibility. As such, while it seems pretty arbitrary, it would be helpful in estimating inflation expectations for the case of Vietnam. Gerlach and Svensson (2003) specify the implicit inflation objective as an underlying trend in the inflation data. A filtering methodology will thus be used to obtain the long-term trend of the data separated from its cyclical component.

The parameter α_{π} in Equation 9 ($0 \le \alpha_{\pi} \le 1$) measures the weight put on the past deviation of inflation from its targeted rates. We may thus interpret $1-\alpha_{\pi}$ as an indicator of the monetary policy credibility. When monetary policy is fully credible, $\alpha_{\pi} = 0$ ($1-\alpha_{\pi} = 1$), the public totally anchors their inflation expectations to the central bank's objective which cannot be influenced by any ex post deviations. Contrarily, when α_{π} is high, the central bank has a weak credibility, the public gradually revises their expectations based heavily on actual inflation outcomes. Past inflation rather than the authorities' objective then plays an important role in shaping public's expectations.

[16] For the sake of simplicity, in the main body of the paper, inflation expectations take the π_t symbol. The definitions of variables in this Appendix do not apply to other parts of the paper. Only the formulations matter.