Determinants and Stability of Demand for Money in Vietnam

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Abstract. This paper explores the determinants and stability of money demand in Vietnam. By applying cointegration techniques, we indicate the role of gold price and real effective exchange rate on the money demand. Real deposit interest rate is not an interesting investment channel compare with holding other assets. CUSUM and CUSUM squared tests do not confirm the stability of money demand function in the investigating period.

1 Introduction

The determinants and stability of the money demand function are important to establish and implement an effective monetary policy. According to Kumar [11], Riyandi [15], and Sriram [17], researchers have been investigating money demand for many years. Following the meta-analysis results and literature surveys, the previous studies of this topic have been considering with many aspects as well as arguments. In contrast, there are just a few empirical researches in Viet Nam [6,13,14]. For developing countries, the demand for money function is more complicated than developed countries. One of the reason is the opportunity cost of holding money, which changes rely on economic properties of each country. It is not only for transaction purpose but also for precautionary and speculative motivation. Therefore, this studying is extremely necessary, especially with a developing country like Viet Nam.

Many conclusions had been given by various estimation method. The researchers have often concentrated problem of modeling selection to find the best appropriate model. To forecast money demand quantity accurately, the model estimation should be evaluated and updated corresponding to the actual economic situation for each country. The remaining concerns should be continuing in further work. This mention suggests further studying money demand to reflect more and more accuracy. In Vietnam, a number of quantitative studies are still limited. One of the main obstacles is estimation method. The method only specified one model to analyze, and propose implication policies [6,13,14].

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It implies that policy makers need much more information to make a decision regarding monetary policy. Money demand function was concluded stable over the period 1996–2006, 1999–2010. Do these factors influence to the money demand function and whether its stability exist or not compared to the previous period studied? The purpose of this study is to investigate factor of money demand and stability over 2003Dec to 2014Dec. What is not yet clear about the impact of real gold price and real exchange rate on especially money demand? The cointegration technique persuades to exam the existence of new relationships. This is the main reason why the paper continues to inspect in detail the determinants of money demand in Viet Nam. In addition, this paper will confirm the stability question over 2003Dec to 2014Dec.

The article is outlined as follow. Section 1 introduces some highlights of money demand. Section 2 presents literature review, and previous researches. Section 3 describes methodology including model, technique, and data. In Sect. 4, the results are presented and discussed. Finally, a conclusion is summarized.

2 Literature Review

The previous studying assumed money market equilibrium criteria to estimate money demand [3]. Money market equilibrium occurs when money quantity that people hold equal to money quantity that people want to hold. Some theories presented such as Irving Fisher, the Cambridge school, neo-classical, Keynes, Minton Friedman,... In fact, the literature review identified that almost researchers used Keynes's theory or Friedman's theory to explain and develop money demand [1,5,7,10,11,15,17,18].

Babic [2] and Kumar et al. [12] summarized three main factors of holding money including transaction, precautionary and speculative motives that Keynes implied. Regarding to transaction, people want to keep the money to exchange in daily and its motive is part is proportional to income. Besides, people want to hold money for unexpected needs. The precautionary motivation is approached following this way. The amount of money that people want to hold is determined by their transaction level in the future. This part also is proportional to income. For speculative motive, the interest rate is an important role that determines money demand for speculative activity. The interest rate has an inverse relationship with holding money [12]. The Keynesian theory also notices a difference between real and nominal money quantity. The main result is emphasized is that there is a negative relationship between money demand and interest rate. By combining these components; the model of demand for money (1) following Keynesian approach presents includes income (Y_+) and interest rate (i_-). Where ($+/-$) signs are positive affect and negative affect.

$$M^d = f(Y_+, i_-) \tag{1}$$

Friedman approached money demand function based on modern money quantity theory. Economists used widely this theory when performing research of money demand function. The money is integrated as an asset classification and money demand function is influenced by some factors related to ownership needs of other assets. From this, money demand function was developed base on asset demand theory. The demand of money is a function which of the availability of resources for personal and expected returns of other asset classes compared with the expected return of the currency. Friedman considered that the velocity of money is high. Therefore, the demand for money function is highly stable and less sensitive to the interest rate [12]. This argument implies that the quantity of money demand can be predicted accurately by money demand. By this approach, he proposed money demand function by formula (2).

$$\frac{M^d}{P} = f(Y_+, r_b - r_{m-}, r_e - r_{m-}, \pi_e - r_{m-}) \tag{2}$$

where is $\frac{M^D}{P}$: demand for real money balances, Y_p: a measure of wealth, π_m: expected return on money, π_b: expected return on bonds, r_e: expected return on equity, π_e: expected inflation rate.

There are various arguments about the impact of interest rate on the stability of the money demand function. Fisher said that money demand function is stable because velocity money is stable. Friedman also accepted to Fisher viewpoint. Meanwhile, Keynes considered that money demand function is not stable due to unstable velocity money [13]. In general, previous researches have established that the demand for money has a positive relationship with scale variables (S) and a negative relationship with the opportunity cost variables (OC). Sriram [18] summarized the Eq. (3) in a survey of theory literature for money demand. Recently, Kumar [11] mentioned some contrasting results between advanced and developing countries that are also figured out cost of holding money. In financial reforms processing, the definitions of monetary aggregates have a quite different result that produces income elasticity estimates [11]. The selection of these variables depends on characteristics of the economic situation for each country [1,7,10,11,15–17].

$$\frac{M^d}{P} = f(S_+, OC_-) \tag{3}$$

Previous Studies of Money Demand in Some Countries and in Vietnam The major findings of empirical studying summarize in Table 1. In the past, there were studies of money demand function in Vietnam by Hoa [6], Nguyen and Pfau [13], and Lan [14]. Most studies selected industrial production value or the gross domestic product to represent the scale variable. The opportunity cost variables of holding money are variously selected. These variables were chosen including deposit interest rate, treasury bills interest rate, consumer price index, exchange rate, and stock price. Gold price and real effective exchange rate have not been reflected in the money demand function in Vietnam. The studying on over the world often focuses on the selection method estimates to make a consistent model [7,9,10,21]. Currently, there has been little quantitative analysis like Vietnam.

Regarding to Vietnam money demand modeling, the empirical studies applied vector error correction model or autoregressive distributed lag to estimate. There is no comparison among these result estimates. It is hard to convince policy makers about implications in future work. On the other hand, some previous studies outside Vietnam applied complicated estimation such as cointegration technique (including FMOL, DOLS, CCR) [7,9], time-varying cointegration [21], neural network [1,10]. It helps analyze and explore the influence factors of money demand clearly. To link actual Vietnam economic situation, the research needs to update such as data source, new explanation variables, improving points of model econometrics to achieve one reliable result. Besides, the most insight of money demand is stable or not. The CUSUM and CUSUM-square result of Hoa [6] and Nguyen and Pfau [13] concluded the money demand stability over the investigating period. This paper will consider cointegration technique including FMOLS, DOLS, CCR in order to expect the new determinants of money demand. Above-mentioned issues will be focused during construct research model construction.

Table 1. Summary of studies on money demand

Author	Money quantity/Period	Country	Variables	Method	Main findings
Alsahafi [1]	M1, M2 93.1-06.3 (q)	Saudi Arabia	GDP, FIDR, EX, FITB, FIGB	VECM, ANN. Johansen cointegration test	GDP (+), FIDR (−), FITB (+). ANN result shows better than VECM
Dogan [5]	M1 02.1-14.12 (m)	Turkey	IP, EX, CPI	ADRL, CUSUM, CUSUMSQ	CPI (−), IP (+), EX (+). M1 is stable
Hoa [6]	M1, M2 94.12-06.12 (m)	Vietnam	IP, CPI, FITB, EX	VECM, CUSUM, CUSUMSQ	IP (+), FIDR (−), FITB (−), EX (−). M1, M2 is stable
Hamdi et al. [7]	M2 80.1-11.4 (q)	Bahrain, Kuwait, Oman, Qatar, Arabia & UAE	GDP, FIDR, REER, FITB	FMOLS, DOLS, CCR, PMGE. Johansen cointegration test	GDP (+), FIDR (−). M2 is stable
Inoue and Hamori [9]	M1, M2, M3 80.1-07.12 (m) 76.1-07.4 (q)	India	(m): IP, FIDR (q): GDP, FIDR	DOLS	IP (+), GDP (+), FIDR (−). M1, M2 is stable
Joseph et al. [10]	M2 97.5-13.2 (m)	United States	GDP, FIDR, CPI, FITB	Linear regression, ANN	GDP (+), FIDR (−), FITB (−). ANN result shows better than the linear model
Kumar et al. [12]	M1 60-08 (y)	Nigeria	GDP, FIDR, EX, CPI	Gregory & Hansen cointegration technique	GDP (+), FIDR (−), EX (−), CPI (−). M2 is stable
Nguyen and Pfau [13]	M2 9.1-09.4 (q)	Vietnam	GDP, CPI, EX, FIDR, St	VECM	GDP (+), CPI (−), St (+), FIDR (−). M2 is stable
Lan [14]	M2 98.1-10.4 (q)	Vietnam	GDP, FIDR, EX	VECM	GDP (+), FIDR (−), EX (−). M2 is stable

Notes: (+/−): positive impact/negative impact.
Abbreviate words: GDP (gross domestic product), CPI (consume price index), FIDR (nominal interest deposit rate), EX (exchange rate), REER (real effective exchange rate), FITB (interest treasure bill), FIGB (interest government bond), St (stock index), IP (industrial production). The period abbreviation including (y), (q), and (m) is defined as yearly, quarterly, and monthly period.

3 Methodology

3.1 Model

In order to analyze the determinants of money demand, this paper considers formula (3) with assuming $M^d = M^s$. Real money supply $M1$ ($M1_r^d$) is selected for the dependent variable. For empirical analysis, scale variable is selected by domestic industrial value (Y_p). The opportunity cost variables included real domestic gold price (G_s), VN-Index (St_s), real effective exchange rate ($REER_s$), real deposit rate (r_s), treasury bills interest rate ($Tbill_s$) and consumer price index (π_s). The research proposes the model by Eq. (4).

$$\ln M1_r^d = \ln Y_p + \ln G_s + St_{vni} + REER_s + r_s + Tbill_s + \pi_s. \quad (4)$$

3.2 Method

This study uses quantitative analysis method including four steps. The first step is unit root test and unit root test with breakpoint structure to check the stationary characteristic of all variables. The second step is Johansens cointegration test to confirm the long-run relationship between these variables. In the third step, model estimation uses different techniques: vector error correction model (VECM), cointegration regression model. Inside cointegration regression model, there are three models including fully modified ordinary least square (FMOLS), dynamic ordinary least square (DOLS), canonical cointegration regression (CCR). The difference between these models is the calculated way of the long-run covariance matrix to remedy model diseases. Finally, the stability of demand function will be confirmed by CUSUM and CUSUM-squared test.

3.2.1 Unit Root Tests

The equation is described by formulas (5), (6), and (7). The difference between three formulas is none variables, intercept variables (α) and "intercept and trend" (γT) variables. The null hypothesis is $H_0(\delta = 0)$ and the alternative hypothesis is $H_1(\delta < 0)$. In case, statistical value is smaller than the critical value. We reject the null hypothesis of a unit root and conclude that Y_t is a stationary process. In case, the null hypothesis cannot reject, we will conclude that Y_t is a non-stationary process. We perform the null hypothesis of a unit root against the alternative hypothesis of stationarity using the Augmented Dickey-Fuller (ADF) and Augmented Dickey-Fuller with breakpoint structure. The null hypothesis is set that the variable has unit root (not stationary). For ADF with breakpoint structure test, we use Zivot and Andrews [20] (see [8]) method to test the unit root hypothesis under structural breaks. All tests have a markup and no tendency in the series.

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + u_t \quad (5)$$

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + u_t \tag{6}$$

$$\Delta Y_t = \alpha + \gamma T + \delta Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + u_t \tag{7}$$

According to IHS Global Inc. [8], Perron figured out structural change and unit root is a close relationship. The researchers considered that unit root test can be biased and does not reject unit root hypothesis when the data are trend stationary with a structural break. This method was added variable structure breaks to conclude wrong stationary level. Perron-Vogelsang and Clemente-Montanes-Reyes suggested testing model units with structural change [8]. Some variables are defined before processing. First, an intercept break variable $DU_t(T_b) = 1, (t \geq T_b)$ that takes the value 0 for all dates prior to the break, and one thereafter. Second, a trend break variable $DU_t(T_b) = 1, (t \geq T_b)$, which takes the value 0 for all dates prior to the break, and is a break date re-based trend for all subsequent dates. Third, a one-time break dummy variable $DU_t(T_b) = 1, (t = T_b)$ that takes the value of one only on the break date and zeroes otherwise. The unit root test with structural changes described by the formula (8), (9), (10), and (11). Similarly, the null hypothesis is $H_0(\delta = 0)$ and the alternative hypothesis is $H_1(\delta < 0)$. If the statistical value is smaller than the critical value, we reject the null hypothesis of a unit root and conclude that Y_t is a stationary process. Otherwise, if we cannot reject the null hypothesis, we conclude that Y_t is a non-stationary process.

Model 1: Non-trending data with intercept break.

$$y_t = \mu + \theta DU_t(T_b) + \omega D_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{8}$$

Model 2: Trending data with intercept break.

$$y_t = \mu + \beta_t + \theta DU_t(T_b) + \omega D_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{9}$$

Model 3: Trending data with intercept and trend break.

$$y_t = \mu + \beta_t + \theta DU_t(T_b) + \gamma DT_t(T_b) + \omega D_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{10}$$

Model 4: Trending data with trend break.

$$y_t = \mu + \beta_t + DT_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{11}$$

where are y_t: data series over test period; k: lag lengths; u_t: white noise; β_t: trending variable and get value from $[1, n]$.

3.2.2 Cointegration Technique

The existence of cointegration is considered when $(y_t, \Delta x_t)$ is stationary at first difference and (u_t, w_t) is stationary at zero difference. In the linear model, the endogenous phenomenon will be affected to bias coefficient estimates of the explanatory variables. The correlation between u_t and w_t causes a problem. The serial correlation phenomenon will be impacted inaccurate the significance level. When using OLS regression, some diseases caused bias estimation relates to β_1, β_2 coefficients (12). ECM model corrects β_1, β_2 coefficients using error correction coefficient (14). The accuracy estimation will be improved.

$$Y_t = \beta_1 + \beta_2 X_t + u_t \tag{12}$$

$$\Longrightarrow u_t = Y_t - \beta_1 - \beta_2 X_t$$

$$\Delta Y_t = \beta_1 + \beta_2 \Delta X_t + u_t \tag{13}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t - \pi\left[u_{t-1}\right] + \varepsilon_t$$

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t - \pi\left[Y_{t-1} - \beta_1 - \beta_2 X_{t-1}\right] + \varepsilon_t \tag{14}$$

Another technique is FMOLS and CCR. The main idea of this method is modified each part of OLS regression using the long-run covariance matrix (15), (16), and (17) to prevent OLS diseases. Meanwhile, the issue of endogenous and serial correlation is resolved. There are three steps to apply this method following [19].

Step 1: Calculate residual u_{1t} from OLS equation and residual u_{2t} from difference equation of Δx_t.

$$y_t = \beta_0 + \beta_1 x_t + u_{1t}$$

$$\Delta x_t = \mu + u_{2t}$$

Step 2: Calculate long-run covariance matrix (LRCOV) of the residuals from combine between residual u_{1t} and residual u_{2t}. Denote $\xi(\Omega) = (u_{1t}, u_{2t})'$. Assume the innovations $ut = (u_{1t}, u_{2t})'$ are strictly stationary and ergodic with zero means (see [19]), contemporaneous covariance matrix Σ, one-sided LRCOV matrix Λ, and nonsingular LRCOV matrix Ω. The long-run covariance matrix is divided into three parts $\Omega = \Sigma + \Lambda + \Lambda'$.

$$\Sigma = E(u_t u_t^{'}) = \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \Sigma_{22} \end{pmatrix} \tag{15}$$

$$\Lambda = \sum_{j=0}^{\infty} E(u_t u_{t-j}^{'}) = \begin{pmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \Lambda_{22} \end{pmatrix} \tag{16}$$

$$\Omega = \sum_{j=-\infty}^{\infty} E(u_t u_{t-j}^{'}) = \begin{pmatrix} \omega_{11} & \omega_{12} \\ \omega_{21} & \Omega_{22} \end{pmatrix} \tag{17}$$

Step 3: While FMOLS method adjusts base on the matrix Ω and Λ, CCR method require another part. It is a matrix Σ. The purpose aims to improve accuracy after modified model. The FMOLS and CCR model describe by (18) and (19).

$$\text{FMOLS:} \quad y_t^+ = \beta_0 + \beta_{fmols} x_t + u_{1t}^+ \tag{18}$$

where coefficient β_{fmols} is calculated y_t^+, λ_{12}^+ and $\omega_{1,2}$.

$$y_t^+ = y_t - \omega_{12}\Omega_{22}^{-1} u_{2t}$$

$$\lambda_{12}^+ = \lambda_{12} - \omega_{12}\Omega_{22}^{-1}\Lambda_{22} \quad \text{(Adjustment coefficient)}$$

$\omega_{1,2} = \omega_{11} - \omega_{12}\Omega_{22}^{-1}\omega_{21}$ (Estimates from covariance u_{1t} under u_{2t} condition).

$$\text{CCR:} y_t^+ = \beta_0 + \beta_{ccr} x_t + u_{1t}{}^+ \tag{19}$$

where coefficient β_{ccr} is calculated by y_t^+, x_t^+.

$$y_t^+ = y_t - \Sigma^{-1}\Lambda_2\beta + \left(0, \omega_{12}\Omega_{22}^{-1}\right) u_t$$

$$x_t^+ = x_t - \left(\Sigma^{-1}\Lambda_2\right)' u_t$$

In contrast to FMOLS and CCR, DOLS uses both lags and leads to adjusting estimated coefficients (20). $M = [c, \alpha, \beta, \gamma]$ contains a set of coefficients for each explanatory variable. $X = [1, P_t, Y_t, A_t]$ contains a set of explanatory variables. m, n, k denote the length between lags and leads.

$$Q_t = X_t M' + \sum_{i=-m}^{i=m} \Phi \Delta P_{1-t} + \sum_{i=-n}^{i=n} \Psi \Delta Y_{1-t} + \sum_{i=-k}^{i=k} \theta_i A_{t-i} + \varepsilon_t \tag{20}$$

3.3 Data

This study uses monthly times series data from 2003 to 2014. The data source includes narrow money supply, deposits interest rate, treasury bills interest rate, consumer price index are collected directly from International Monetary Fund (IMF). Due to more opportunity cost of demand for money in Vietnam, difference data are obtained from General Statistics Office (GSO), vietstocks and [4]. They are gold price index, industrial production value (from GSO), nominal gold price, Vietnam stock index (from Vietstocks), real effective exchange rate from Darvas [4]. To standard and adjust data, this paper computes and presents in natural logarithm form for $M1_r^d$, $\ln G_s$, Y_p. Then, these variables also are deseasonalized using seasonal dummies. Others (St_s, $REER_s$, r_s, $Tbill_s$, π_s are presented by percentage. The real interest rate (r_s and $Tbill_s$) are measured by the formula $i_r = (i_n - \pi)/(1+\pi)$, where, i_r, i_n, π are the real interest rate, expected inflation, and nominal interest rate. From 2003Dec to 2009Mar, SJC nominal gold price is not available. The research infers the data following $G_{t-1} = (G_t * 100)/gold_{index}$. This index ($gold_{index}$) means the current month gold price index compared to the previous month. When using quarterly data, previous research recommended use gross domestic product or gross national product to get a better evaluation. Variable Y_p is selected to present scale variable.

4 Empirical Findings and Discussion

Unit Root Test with Breakpoint Structure. Table 2 summarizes the outcomes of ADF and ADF with breakpoint structure unit root tests on the level and first differences of the variables. The null hypothesis cannot reject that all the variables are unit root at zero difference. However, all of them are stationary with 1% significance level when conducted the first difference. The result suggests that all variables are I(1), which supports the use of the cointegration approach. At first difference, the break date gap shows smaller around 2007–2010 period. It is consistent with the world economy crisis in 2008. Some break dates did not match in 2008. The research considers that there is a latency when this crisis affects to Vietnam economy.

Table 2. Result of unit root test

Variables	Augmented Dicky Fuller (ADF) test statistics		Augmented Dicky Fuller (ADF) with breakpoint structure test statistics			
	Level	1st difference	Level	Break date	1st difference	Break date
$\ln M1_r^d$	−2,582	−5,920^{*1}	−3,812	2011m2	−8,845^{*1}	2008m2
$\ln G_s$	−0,522	−7,859^{*1}	−3,569	2011m2	−10,484^{*1}	2006m6
$\ln Y_p$	−1,959	−13,315^{*1}	−4,081	2010m11	−13,576^{*1}	2011m8
St_s	−2,532	−6,587^{*1}	−5,458	2007m11	−7,895^{*1}	2007m3
$REER_s$	−2,334	−8,891^{*1}	−3,379	2010m7	−9,926^{*1}	2008m12
r_s	−0,518	−10,342^{*1}	−3,728	2007m12	−14,997^{*1}	2007m1
$Tbill_s$	−0,923	−7,532^{*1}	−3,261	2008m2	−10,214^{*1}	2008m7
π_s	−2,220	−4,758^{*1}	−3,205	2010m11	−6,351^{*1}	2010m9

Note: Zt statistic tests is the null hypothesis that the variables contain a unit root. ($*^1$), ($*^5$), and ($*^{10}$) reject the null at 1, 5, and 10 %, respectively. ADF with breakpoint structure test is selected using the Andrews and Zivot method.
ADF: 1% = −4,022 ($*^1$), 5% = −3,443 ($*^5$), 10% = −3,143 ($*^{10}$).
ADF with breakpoint structure: 1% = −5,57 ($*^1$), 5% = −5,08 ($*^5$), 10% = −4,82 ($*^{10}$).

Table 3. Result of lag selection

Lags	LR	FPE	AIC	HQIC	SBIC
0	-	655,313	24,583	24,655	247,603
1	2781,6	7,60E−09	401,216	466,072	5,60833*[5]
2	223,63	$3{,}7 \times 109$*[5]	3,27081*[5]	4,49586*[5]	62,858
3	93,37	$4{,}90 \times 109$	353,926	534,081	797,307
4	100,86*[5]	$6{,}40 \times 109$	374,963	612,767	960,227

Note: (*[1]) and (*[5]) denote the significance at the 1%, 5%, and 10% level, at respectively.

Table 4. The result of Johansen tests for cointegration.

Max rank	Eigen value	Trace statistic	5% critical value	1% critical value
0	-	2,120,584	170,8	182,51
1	0,43647	136,9243*[1]	136,61	146,99
2	0,27784	94,2828*[5]	104,94	114,36
3	0,233	595,332	77,74	85,78
4	0,16278	362,584	54,64	61,21
5	0,1177	198,535	34,55	40,49

Note: (*[1]) and (*[5]) denote the significance at the 1%, 5%, and 10% level, at respectively.

Cointegration Test. After investigating the time series properties of all the variables, the research identifies the existence of long-run equilibrium. First, Table 3 gives the optimal lag though FPE, AIC, HQIC, SBIC criteria. The lag selection result supports to select two lags for model estimation. The result of Johansen test is tabulated in Table 4. The critical value (146.99) exceeds the trace test (136.92) at 1% significance level. It implies to reject the null hypothesis. At 5% significance level, the null hypothesis cannot reject ($94.28 < 104.94$). For more than one cointegration vector, the maximum rank indicates that there are one cointegration equations at 1% significance level and two cointegration equations at 5% significance level. Because all variables are stationary at 1% significance level respectively, the research chooses one cointegration equation to analyze next step.

Short-Run Estimates. For short-run, the estimation result reports in Table 5, which indicates that four parameter estimates (St_s, $REER_s$, r_s, $Tbill_s$) affect to demand for $M1$ money and had significance at 1% level, except at 5% level. The research cannot prove the impact of $\ln G_s$, $\ln Y_p$, and r_s to $M1$ money demand. There is a short-run relationship between dependent variables and independent variable because the error correction coefficient shows -0.034. When real $M1$ money demand deviated from equilibrium status, it will be adjusted up about 3.4% in the next term to recover equilibrium status. The model in short-run is

Table 5. Estimation result of M1 money demand in the short-run.

Variables	Coefficient	Standard error	p-value
$ECT(-1)$	−0,0340634	0,0167926	0,043*
$\Delta \ln M1_r^d(-1)$	0,0617752	0,0852173	0,469
$\Delta \ln G_s(-1)$	0,0471475	0,0829781	0,570
$\Delta \ln Y_p(-1)$	0,0270579	0,0206414	0,190
$\Delta St_s(-1)$	0,0001469	0,0000563	0,009***
$\Delta REER_s(-1)$	0,4521859	0,2108798	0,032**
$\Delta r_s(-1)$	−0,0007669	0,0019962	0,701
$\Delta Tbill_s(-1)$	−0,0058979	0,0024104	0,014***
$\Delta \pi_s(-1)$	−0,0211578	0,0042211	0,000***
Constant	0,0157713	0,0042211	0,000***

Note: (*), (**), and (***) denote the significance at the 1%, 5%, and 10% level, at respectively. Lag character is denoted in parentheses (−1).

written by the formula (21). Where lag character is denoted in parentheses (−1). ECT(−1) means error correction term with one lag.

$$\begin{aligned}\Delta \ln M_r^d(-1) = &-0,0340634 ECT(-1) + 0,0617752 \Delta \ln M_r^d(-1) \\ &+ 0,0471475 \Delta \ln G_s(-1) + 0,0270579 \Delta \ln Y_p(-1) \\ &+ 0,0001469 \Delta St_{vni}(-1) + 0,4521859 \Delta REER_s(-1) \\ &- 0,0007669 \Delta r_s(-1) - 0,0058979 \Delta Tbill_s(-1) \\ &- 0,0211578 \Delta \pi_s(-1) + 0,0157713. \end{aligned} \quad (21)$$

First, contrary to expectation, the negative relationship between gold price and $M1$ money demand has no meaning in short-term. In some periods, gold price increased dramatically. Vietnamese people rushed to buy gold but their expectation could not reply as much as possible. A possible explanation for this might be that there is the lack of domestic gold supply, the limited of selling gold quantity by speculators, and the commitment of the state government bank about stabilized local currency and managed the gold market. Second, there is no evidence to figure out the effect of industrial production value determinant to $M1$ money demand. Third, variable provided statistically significant and positive effect. This relationship is given against Friedman's theory that was mentioned the negative relationship between money demand and expected return. However, the empirical research of Nguyen and Pfau [13] supports for this determinant. It is difficult to explain this result, but it might be related to the weak confidence of the people in Vietnam stock market. Due to the instability of the stock market, limited of the transparency, people tend to prefer trading style rather than dividend payment yearly. This rate of return comes from the arbitrage between the purchase price and the sale price. Hence, holding money and holding stock have a positive relationship. The stock elasticity of demand for $M1$ money is very slight. In case, other factors are constant, real $M1$ money demand will increase 0.015% when the stock changes 1%. This minor impact reveals that a promising alternative asset does not attract domestic investors. Fourth, the real effective exchange rate is positively at 5% significance level and strongly influenced by $M1$ money demand (0.45). Regarding holding money, the exchanges rate are one of the opportunity costs variable and is expected to reverse with $M1$ money demand. However, according to the alternative asset approach, when local currency depreciated, people will hold more assets [6]. It implies that domestic goods are cheaper than foreign goods. People tend to hold more local currency in order to buy more assets that are domestic. Fifth, the deposit interest rate has no statistically significant. It was same as Friedman's conclusion that money demand is less sensitive than the interest rate. For developing country, the inflation is often high and fluctuates. It leads to the negative real interest rate in some periods. People balance between savings channel and other investment channels. In addition, the state bank of Vietnam decided deposit interest rate ceiling to control lending interest rate of commercial banks. The attraction of saving money can be decreased. The research considered that this result is appropriate in short-term for Vietnam. Sixth, the treasury bills interest rate are negatively at 1% significance level. This result is similar Friedmans conclusion that money demand is negative with the bond return. By assuming, others factors are constant, $M1$ money demand will fall 0.59% when treasury bills rise 1%. Although this investment channel is considered very low risk, holding treasury bill is small. The lower risk causes lower profit. Therefore, it can explain why this effect has a small influence. Seventh, consumer price index is negative with real $M1$ money demand. The coefficient is small. In case other factors constant, the growth rate of real $M1$ money demand decreased 2.12% when the consumer price index increases 1%. Vietnam is still developing country. To reduce the risk, people balance between holding other alternative assets and holding money. Hence, this thing may explain the relatively correlation between the consumer price index and demand for money.

Long-Run Estimates. In long-run, the results present in Table 6 that four cointegration models given different results relate to sign expectation, model explanation (R-square). While VECM uses error correct coefficient to adjust, FMOLS and CCR use long-run covariance matrix. Conversely, DOLS uses lead and lag to adjust. These methods corrected standard OLS regression relate to serial correlation and endogeneity of regressors. The outcomes of VECM, FMOLS, CCR and DOLS reveals that all the dependent variables are statistically significant. Following the comparable results, CCR model is well determined because its outputs display higher meaning explanation and significance level than other techniques. In long-term, $M1$ demand function is written by the formula (22).

$$\begin{aligned}\Delta \ln M^d_{r_{CCR}} &= 105,9 - 0,245\Delta \ln G_s + 0,282\Delta \ln Y_p + 0,00031\Delta St_{vni} \\ &\quad - 0,753\Delta REER_s - 0,0245\Delta r_s + 0,0117\Delta Tbill_s - 0,00757\Delta \pi_s \end{aligned} \tag{22}$$

Table 6. Estimation result of M1 money demand in the long-run.

Variables	VECM	FMOLS	CCR	DOLS
	$\ln M1_r^d$	$\ln M1_r^d$	$\ln M1_r^d$	$\ln M1_r^d$
$\ln G_s$	−0,4595683**	−0,242***	−0,245***	−0,147*
	(0,2336489)	(0,0510)	(0,0520)	(0,0840)
$\ln Y_p$	0,5403968***	0,282***	0,282***	0,324***
	(0,2014496)	(0,0360)	(0,0478)	(0,0860)
St_s	−0,0013442***	0,000308***	0,000310***	0,000412***
	(0,0001489)	(2,93e−05)	(3,45e−05)	(6,40e−05)
$REER_s$	−4,324238***	−0,772***	−0,753***	−0,441
	(0,914772)	(0,163)	(0,199)	(0,380)
r_s	0,0843073***	−0,0245***	−0,0245***	−0,0383***
	(0,009864)	(0,00197)	(0,00235)	(0,00397)
$Tbill_s$	−0,1001702***	0,0117***	0,0117***	0,0278***
	(0,0107419)	(0,00209)	(0,00250)	(0,00460)
π_s	−0,0089349**	−0,00745***	−0,00757***	−0,00738***
	(0,0049226)	(0,000995)	(0,00111)	(0,00192)
Constant	395,3594	107,8	105,9	71,31
Observe	131	132	132	129
R^2	0,3782	0,841	0,869	0,971

Note: (*), (**), and (***) denote the significance at the 1%, 5%, and 10% level, at respectively.
The standard errors are in parentheses ().

As our expected, the estimated coefficient of $\ln G_s$, $REER_s$, r_s, and π_s that is negative and significant at 1% level of significance. In contrast, $\ln Y_p$, St_s, and $Tbill_s$are positive at the same significance level. First, industrial production value has the same direction with M1 money demand. This result is consistent with the theory of Friedman, previous studies of [6]. Second, the domestic interest rate represents the opportunity cost of holding money. When the money supply increases, the interest rate will fall. It encourages people willing to hold more money in cash. However, when interest rate rises, the people prefer holding more financial assets such as treasury bills, bonds, etc. Third, the positive sign of between treasury bills interest and the demand for M1 money. This result does not match Friedman's conclusion. Assuming money market balance, if the public holds less than the amount of money, they will hold more bonds. It causes a bond price increase. When the price of bonds rises, the interest rate will fall. Fourth, regarding gold price in the long-run relationship, the negative effect strongly influences to money demand. The coefficient is large. It reveals that holding gold needs is still high in addition to holding money. Fifth, the real effective exchange rate does not consistent the result in short-term. This proves that people tend to less holding money when the local currency decreases. The coefficient of $\ln G_s$

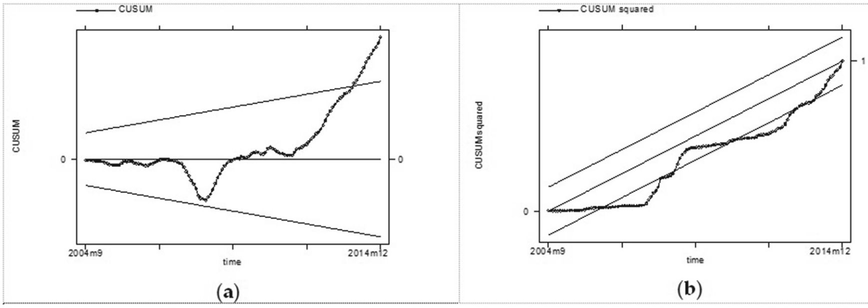

Fig. 1. The result of CUSUM and CUSUM-square for M1 money demand. (a) Description of CUSUM result; (b) Description of CUSUM-square result.

(−0.245) and $REER_s$ (−0.753) show the considerable impact on real M1 money demand function. In fact, the holding gold and foreign currency are two main channels in parallel holding money. According to the above results, there is two main factors impact to money demand in Vietnam. They are $\ln G_s$ and $REER_s$. These facts are important for state government to control money demand more effective. Seventh, π_s variable also affect negatively to money demand same as the short-run relationship.

Stability Tests. We use CUSUM and CUSUMSQ test to confirm whether stable or not for 2003Dec to 2014Dec periods. The CUSUM test provides the recursive estimates of residuals. It calculated CUSUM statistic. Under the null hypothesis, the statistic is drawn from a distribution. If the calculated CUSUM statistics was put inside the drawn line of CUSUM distribution, we reject the null hypothesis (meaning model stability). The null hypothesis is that parameters are stable (constant). Previous studies by Hoa [6], Nguyen and Pfau [13] concluded the stable of M1 money demand function. The stability test of money demand in Vietnam was described in Fig. 1 though CUSUM and CUSUMQ test. In contrast to earlier findings, the result illustrates that M1 demand function does not conclude stable over the 2003Dec–2014Dec period.

5 Conclusions

This paper has investigated the factors, which affect to narrow money demand (M1) using cointegration technique from 2003Dec to 2014Dec. By empirical analysis, we figure out the role of gold price and real effective exchange rate with strongly significant in money demand. Obviously, cointegration technique using FMOLS, CCR, and DOLS demonstrate the outcomes better than VECM in long-run equilibrium. The model regression is modified using the long-run covariance matrix. The data is estimated with caution because this technique prevents the issue of endogenous and serial correlation. Therefore, the new findings of demand for money in Vietnam have identified. The real interest rate is not an interesting investment channel compare with holding other assets. In developing financial market such as Vietnam, the asset price is one of the extremely important points in money demand. The next studying direction should be investigating the effect of these factors in Vietnam monetary policy. In addition, future work can be study money demand function modeling by combining linear and nonlinear method.

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