An Analysis of Demand for Money
in the Lao People's Democratic Republic

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Abstract

This paper is aimed at exploring the dynamic relationship between money balance and four other macroeconomic variables: real GDP, expected inflation, exchange rates, domestic and foreign interest rates by modeling and testing for stability of money demand functions in the Lao People's Democratic Republic (PDR) during the period of 1993:Q1-2010:Q2. Demands for narrow money, broad money and board money in foreign currencies were estimated. The estimated results suggested that all demand functions are stable. They can be intermediate targets of the Bank of the Lao PDR. The substantial results point out: (i) there is an evidence of ample influence of exchange rates and interest rate on money balances in the Lao PDR; (ii) expected inflation indicates the effect of high inflation episodes on money balances, especially in terms of foreign currency, and (iii) the local currency, the Kip, is used predominantly for transaction purposes rather than foreign currencies.

Keywords: Demand for money, long-run relationship, narrow money, broad money, error correction model.

1. Introduction

Demand for money plays a major role in macroeconomic analysis, especially in selecting appropriate monetary policy actions. Consequently, a steady stream of theoretical and empirical research has been carried out worldwide over the past several decades.

Money demand function was first conducted in developed countries where financial systems developed and the central banks realized the role of money demand in conducting monetary policy. However, lately there has been considerable interest among several other industrial and developing countries.

The Lao PDR is in the process of a transition towards a market economy. The Lao economy has experienced high fluctuations of inflation rates. Monetary growth rates have not been calculated by considering the demand side. The implementation of financial sector policies has been slow in solving several issues. The monetary policy framework is limited and incomplete. It is mainly based on the obligation and issuance of bonds while BOL credit and marketing officers may have not yet used them. It is for such reasons that the sources of money and credit are restricted. The exchange rate mechanism is not yet fully consistent with the actual conditions, thereby limiting the efficiency of its implementation. The main tools of BOL are interest rates, reserve requirements, and discount window lending. The BOL has only used open market operations since the Laos stock market has been opened for more than one year.

The financial market is developing within a limited scope. Credit is limited and meets only 15 percent of the requirements with high non-performing loans. The Lao economy is also partially dollarized. The total amount of foreign currency deposits to broad money was 59.3 percent in 1992 and 55 percent to the end 2011.

Therefore, in order to control the banking system efficiently, BOL should consider the demand side when conducting monetary policy. Up to now, there is no empirical study about money demand for the Lao economy. Thus, this is the first study about demand for money for the Lao PDR.

This paper aims to explore the dynamic relationship between money balance and four other macroeconomic variables: real GDP, expected inflation, exchange rates, and domestic and foreign interest rates by modeling and testing for stability of money demand functions in the Lao PDR during the period of 1993:Q1-2010:Q2. The paper is structured as follows: Section 2 gives theoretical and empirical overviews about demand for money. Section 3 presents the empirical results and analysis of the results. Section 4 includes the conclusion and provides policy implications of the findings.

2. Overview of theoretical and empirical studies on money demand

2.1. A brief theoretical overview

There is a stream of theories about demand

for money. Theoretical developments on money demands began from the classical tradition. All theories try to explain two motives for holding money, namely transaction motive and asset motive.

2.1.1. Quantity theory of demand for money

The quantity theory of demand for money proposes a direct and proportional relationship between the quantity of money and the prevailing price level. This relationship emerges within the classical equilibrium framework using two separate, but equivalent expressions. The first expression is associated with the American economist, Irving Fisher and is called the "equation of exchange". The second expression is associated with Cambridge University's Arthur C.Pigou and is called the "Cambridge approach" or the "cash balance approach".

a) Fisher's "equation of exchange"

Fisher's equation of exchange provides an important relation between four macroeconomic variables to determine the nominal value of aggregate income. The four variables in the equation of exchange are: the total amount of money in circulation (M), an index of the total value of aggregate transactions (T), the price level of articles traded (P), and a proportionality factor (V) denoting the "transaction velocity of money". The equation is given below:

$$MV = PT \qquad (1)$$

The classical economists (including Fisher himself) built on this relationship in the nineteenth and early twentieth centuries. Since the classical economists believed that wages and prices were completely flexible, they posited that the level of aggregate output produced in a normal economic period (Y) would remain at the full employment level, so Y by definition is a nation's total potential level of output. Fisher assumed that the ratio between the level of transactions, T, and output, Y, is reasonably stable ($Y = txT$) and hence T can be treated as a constant in the short-run.

Fisher believed that the velocity of money, V, is determined by the institutions in an economy, because these directly affect the way in which individuals conduct transactions. For example, if consumers use charge accounts and credit cards to conduct their transactions, and consequently use money less often when making purchases, less money is required to conduct the transactions generated by nominal income (M decreases relative to PT). Hence, velocity, defined as $(PT)/M$, will increase. On the other hand, if consumers find it more convenient to purchase items with cash or checks (both of which are counted as money), more money is used to conduct the transactions generated by the same levels of nominal income, hence velocity will fall. Fisher theorized that institutional and technological features of the economy that affect velocity change only slowly over time, so velocity can safely be considered constant in the short-run. By dividing both sides of the equation of exchange by V, the money demand function is obtained:

$$M^d = (1/V)PT \qquad (2a)$$

Or equivalently,

$$M^d = kPT \qquad (2b)$$

Equation (2b) states that because k is a constant in the short-run (because V and T are constant in the short-run), PT pins down the quantity of money that people demand, M^d. Fisher believed that people hold money only to conduct transactions and have no freedom of action in terms of the amount they want to hold. The demand for money is determined by the level of transactions generated by the level of nominal income, PY, and by the institutions in the economy that affect the way people conduct transactions that determine velocity, V, and hence k. Therefore, Fisher's quantity theory of money suggests that the demand for money is purely a function of income. Interest rates have no effect on the demand for money.

b) Cambridge approach to money demand

A group of classical economists, including Alfred Marshall and Arthur C. Pigou in Cambridge studied the demand for money by considering how much individuals want to hold, given a set of circumstances. Pigou held the central assumption that individual demand for money is driven by the institutional environment, as this is the main factor that affects whether individuals use money (i.e., cash and check) to conduct transactions. In the Cambridge model, individual demand for money is completely bound by institutional constraints, such as whether one can use credit cards to make purchases. Instead, individu-

als desire money because money is a medium of exchange and a store of wealth. Cambridge economists concluded that money demand would be proportional to nominal income and expressed the demand for money function as:

$$M^d = kPY \qquad (3)$$

In the short–run, k is the constant of proportionality and money demand does not depend on the interest rate. However, money demand can depend on the interest rate when velocity is not constant over time.

From the above discussion, the quantity theory of money emerges as the theory with a simpler approach to estimating money demand. The estimating equation is:

$$MV = PY \qquad (4)$$

where M denotes nominal money stock, V denotes the income velocity of circulation, P denotes the prevailing price level and Y denotes real income.

Note that the elegant expression for money demand given by the quantity theory of money relies on the assumption of constant velocity. In reality, however, the velocity is not constant especially during periods of financial liberalization. In these cases, equation (4) cannot capture the complex relationship between the money demand and other macroeconomic variables. Hence, we will turn to two other approaches to the theory of money demand: the Keynesian approach and Friedman's modern quantity theory approach. Both approaches consider the demand for money as part of the general issues of wealth allocation, but place

emphasis on different aspects of the problems.

2.1.2. Keynesian approach

In 1936, Keynes offered a theory of demand for money that emphasized the importance of interest rates. Keynes' theory of money demand (referred to as liquidity preference theory), focuses on factors that influence individual decision-making. He postulated that there are three motives driving the demand for money: transaction motive, precautionary motive, and speculative motive. With this view, money demand is a function of real income (Y) and interest rate (r).

$$M / P = f(r, Y) \tag{5}$$

Equation (5) has the key implication that velocity is not constant and is positively correlated with the interest rate, which fluctuates substantially. Initially, Keynes suggested a liquidity-preference schedule as in the following equation:

$$M^d = M1 + M2 = M1(Y) + M2(r) \tag{6}$$

where: M^d is the total demand for money, $M1$ is the sum of transaction and precautionary demands, and $M2$ is speculative demand. In this schedule, transaction and precautionary demand depends only on the level of income, Y, where $dM1/dY > 0$. The speculative demand depends only on the level of interest rate, r, where $dM2/dr < 0$.

Although the Keynesian approach to analyzing the demand for money focuses on the three motives for holding money, the models do not allow us to uniquely identify an individual's particular motive for holding money.

However, this is not an important weakness of these models because all three motives together influence an individual's optimal level of money holding.

2.1.3. Friedman's model of the demand for money

In 1956, Friedman developed the modern quantity theory of demand in a famous article, "The quantity theory of money: A restatement". He simply stated that the demand for money must be influenced by the same factors that influence the demand for any other asset. An individual's demand for money should be a function of his wealth and his expected relative (to money) return on alternative investments.

Friedman developed his theory on the demand for money within the context of the traditional microeconomic theories of consumer behavior and of the producer demand for input. Consumers hold money because it yields a direct utility stemming from the convenience of holding an immediate form of payment. Producers hold money because it is a productive asset that smooths the payment and expenditure streams over time. Therefore, the sum of demand for money by both consumers and producers is the demand for real balances. Intuitively, this demand should depend on the level of real income (or real output) as well as on the returns of alternative assets such as bonds or durable goods (for consumers). Therefore, the equation below gives us the demand function for real balances:

$$rm = M/P = f(Y, r_1, r_2, ..., r_n) \tag{7}$$

where *rm* is the demand for real balances and the sequence $r_1, r_2, ..., r_n$ represent the real rates of return on alternative (i.e., non-money) assets.

In particular, Friedman considers durable goods as an important category of alternative assets to money for consumers. With this view, the demand for consumers' durable goods depends on the expected inflation rate, π_e. Then, the demand function for real balances also depends on the expected rate of inflation.

$$rm = f(Y, r, \pi_e) \tag{8}$$

where $drm/dY > 0$, $drm/dr < 0$ and $drm/d\pi_e < 0$

In conclusion, all money demand models can be broadly lumped into three separate frameworks namely, transactions, asset and consumer demand theories of money. The optimal stock of real money balances is inversely related to the rate of return on earnings of alternative assets and is positively related to real income. This is the starting point of all empirical studies.

2.2. Some empirical problems in estimating money demand functions

All empirical studies are based on a conventional textbook formulation of a simple theoretical demand for money function, , relating demand for real money balances (*rm*) to a measure of transactions or scale variable (*Y*) and the opportunity cost of holding money (*r*). However, the demand for money functions estimated for different countries are not the same because of differences in the definition of dependent variables, availability of scale variables, and financial development…

2.2.1. Definition of money

Empirical studies have focused on three monetary aggregates *M*1, *M*2, and *M*3. The component of monetary aggregate differ from country to country and depends on many factors, e.g., a country's level of financial market development. Economists have shown that studies that interchange the use of *M*1, *M*2, or *M*3 to estimate the demand for money face the problem of estimating heterogeneous assets. For example, cash and demand deposits may differ significantly in terms of transaction costs, risks of loss, and ease of concealment of illegal or tax-evading activities. One solution is to separately estimate the demand functions for cash and demand deposits. This approach has yielded more robust empirical results, but it does not resolve the underlying empirical difficulties. Any analysis in the Lao PDR will face similar issues regarding the definitions of money and should leverage the advances made by economists to deal with these empirical problems.

2.2.2. Scale variable

Recently, scale variables were typically created by using data on a country's *GNP*, permanent income or wealth, and cash measured in real terms. A number of other related variables that move together with *GNP*, such as net national product (*NNP*) and *GDP* have also been heavily utilized in creating scale variables without any significant differences induced by the substitution. Traditionally,

GNP has been used for transaction-oriented models, while modern-quantity theories relied on permanent income.

Whichever measure of transactions is ultimately chosen, the question of whether it can be disaggregated into several scale variables remains an open question. Economic aggregate proxies for scale variables in estimating demand for money function depend much on development of statistic systems and available data.

2.2.3. Opportunity cost of holding money

Interest rates in money demand function includes two groups: the own-rate of money and the rate of return on alternative assets. Tobin (1958) and Klein (1974) argue that both of these rates are important and should be included in any model for the demand for money. This may be the interest rates of government securities, commercial paper, or saving deposits. In countries where the financial sector is not well developed and that also suffers from hyperinflation, the expected rate of inflation is also a useful variable to calculate the opportunity cost of holding money.

2.3. Some Asia-specific studies on the money demand function

A large body of literature is available to estimate money demand functions. The initial work in this area was confined primarily to industrial countries, especially the U.S. and the U.K. However, there has also been considerable attention paid to studying the money demand function in developing countries in Asia and South Asia. Various central bank officials realize that understanding money demand function is the cornerstone of monetary policy. In this section, the set studies are carefully chosen on the basis of potential relevance to the Lao PDR context.

Some Asia-specific studies (Fan and Liu (1970); Aghevli et.al (1979); Khan (1980); Tseng and Corker (1991); Watanabe S. and Pham T. B. (2005); Nguyen, D. H., and W. D. Pfau, (2010); Hoa, H.Q. (2008); Dat, T.T. and Hoa, H.Q. (2010)) show that demand for money is a proportion of income level, and this is constrained by a measure of the wealth that can be proxied by either income or permanent income. The demand for money fluctuates with changes in the opportunity cost of holding money. This opportunity cost depends on the relative return on non-money assets such as other financial investments and real goods. In addition, expectations are important. The demand for money depends not only on the prevailing level of factors such as the interest rate and inflation, but also on the future expected values of each of these factors. In the case of dollarization, the interest rate of the dollar and the exchange rate are also an interesting explanation for demand for money balances.

In developed countries, the nominal interest rate considers an appropriate proxy for the opportunity cost of holding money, whereas the weak financial markets and administrative interest rates are the overriding feature in most

developing countries. In most developing countries the nominal interest rate is institutionally determined and it doesn't fully capture the opportunity cost of holding money. Furthermore, the administrative nominal interest rates are not often adjusted for changes in inflation and consequently real interest rates become negative. Therefore, to overcome this problem, researchers often use the consumer price index as the proxy for the interest rate variable. In fact, asset substitution in developing countries usually takes place between money and real assets as inflation hedges and not between money and other financial assets. Thus the expected rate of inflation rather than the nominal interest rate can be regarded as a better proxy for the opportunity cost of holding money in developing countries.

3. Estimating money demand function for the Lao PRD

3.1. Estimation Model

The theory-based money demand function for the Lao PRD is assumed to take the following form:

$$M^d/P = \alpha_0 + \alpha_1 Scale\ Variable\ (Y)$$
$$+ \alpha_2 Opportunity\ Cost\ Variable(r) \quad (9)$$

where M^d is money demand balance, P is the price level, is therefore the demand for real money, Y is the real income that represents the scale variable and r is the interest rate on the alternative assets which represents the opportunity cost variable. The selections of the scale variable and the opportunity cost of holding money depend on the theoretical background

of money demand function and vary among empirical studies.

Following the empirical literature on money demand in developing countries (Goldfeld and Sichel, 1990), the long-run money demand can be specified in the following (natural) logarithmic form:

$$\ln rm_t^d = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln i_t + \beta_3 \pi_t^e + \varepsilon_t \quad (10)$$

In most empirical studies, the interest rate term is used in non-logarithmic form, which leads to the following:

$$\ln rm_t^d = \beta_0 + \beta_1 \ln y_t + \beta_2 i_t + \beta_3 \pi_t^e + \varepsilon_t \quad (11)$$

where rm_t^d is the desired demand for real money balances, defined as the demand for money supply deflated by the price level p, y_t is a scale variable (for example, real measured income), i_t is the nominal interest rate on financial assets, which represents alternatives to holding money, π_t^e is expected inflation which measures the rate of expected return on physical assets, and ε_t is an error term. The function rm_t^d is increasing in y_t, and decreasing in both i_t and π_t^e. When physical assets represent the major alternative to holding money in high or hyperinflationary countries, the money demand may be specified as a function of expected inflation alone $M^d/P = f(\pi^e)$ (Peter Bofinger, 2001).

In developed countries, the nominal interest rate is considered as an appropriate proxy for the opportunity cost of holding money, whereas in most developing countries, the nominal

interest rate is institutionally determined and it does not fully capture the opportunity cost of holding money. Furthermore, the administrative nominal interest rates are not often adjusted for changes in inflation and consequently the real interest rate becomes negative. Therefore, to overcome this problem, economists often use inflation rates as a measure of the opportunity cost of holding money (Bahmani-Oskooee and Tanku, 2006).

$$\ln rm_t^d = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln cpi_t + \varepsilon_t \quad (12)$$

In fact, asset substitution in developing countries usually occurs between money and real assets as inflation hedges and not between money and other financial assets. Thus the expected rate of inflation, rather than the nominal interest rate, can be regarded as a better proxy for the opportunity cost of holding money in developing countries. Furthermore, given the fact of currency substitution in some developing countries, many studies suggest to include nominal exchange rate as an explanatory variable in the estimated equation (Samreth and Sovannroeun, 2008).

$$\ln rm_t^d = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln cpi_t + \beta_3 \ln er_t + \varepsilon_t \quad (13)$$

To capture the effects of foreign factors, many studies on the demand for money in developing countries have included the impact of foreign interest rates and the expected rate depreciation of the domestic currency (Oluwole and Olugbenga, 2007).

$$\ln rm_t^d = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln cpi_t + \beta_3 \ln er_t + \beta_4 i_t^* + \varepsilon_t \quad (14)$$

The inclusion of foreign interest rates in the money demand function is to capture the effect of capital mobility and the expected exchange rate captures the substitution between domestic and foreign currencies. Its impact on the demand for money can be either positive or negative.

The error correction model (ECM) is used to determine money demand and explain the dynamics of the economic model equation (15) if observed variables are non-stationary and they are co-integrated (Engle and Granger, 1987). If the obtained results from unit root tests and the co-integration test of Johansen approach are provided as in the Engle and Granger representation theorem, then the short run dynamics of money demand can be described by ECM. The model in general form presents as:

$$\Delta \ln rm_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln rm_{t-i} + \sum_{i=0}^{n} \beta_{ji} \Delta \chi_{t-i}$$

$$+ \gamma_1 EC_{t-1} + \varepsilon_t \quad (15)$$

$$EC_{t-1} = \ln rm_{t-1} - \beta_0 - \beta_1 \chi_{t-1}$$

where EC_{t-1} is error-correction term, which is derived from the long-run relationship and γ_1, is speed of adjustment to long run equilibrium. χ_t is a set of explanatory variables. Equation (15) will be estimated by OLS method.

The ECM has proved to be the most successful tool in researching money demand. This type of formulation is a dynamic error-correction representation in which the long-

run equilibrium relationship between money and its determinants is embedded in an equation that captures short-run variation and dynamics. The ECM is shown to contain information on both the short- and long-run properties of the model with disequilibrium as a process of adjustment to the long-run model. In addition, the long-run equilibrium is specified by economic theory while short-run dynamics are defined from the data. When co-integrated holds and if there is any shock that causes disequilibrium, there exists a well-defined short-run dynamics adjustment process such as error-correction mechanisms that will put back the system toward long-run equilibrium.

3.2. Data description and issues

The data used in this analysis is taken from the BOL. The estimated sample uses quarterly data in the period from Q1/1993 to Q2/2010.

The study will apply both narrow money $M1$ and broad money $M2$ as dependent variables. In addition, given the fact that there is the multi-currencies use phenomenon in the Lao PDR, hence, monetary aggregate will be classified by currency as local currency (Kip) and foreign currencies. $M1$ is narrow money including cash in circulation and current account. $M2$ is broad money consisting of $M1$, savings and time deposits.

According to the data availability, the scale variable used in this study will be gross domestic product (GDP) as an income measurement.

Expected rate of inflation, exchange rates and interest rates are used as proxies of opportunity costs of holding money in Lao PDR. The past value of the actual inflation is used as a proxy of expected inflation rate. The quarterly series of saving USD interest rate is used as a proxy of foreign currency interest rate due to USD deposits taking the highest proportion. Average exchange rates Kip/Dollar and Kip/Baht are used as proxies of exchange rate.

3.3. The empirical results

As a result of the non-stationary I(1) process in each series and co-integrating relations, the ECM is estimated to capture the long run relationship of money demand. On account of the VARs method and Johansen tests, it considers the effects of all series in the whole system and verifies the co-integration of the multivariate non-stationary which is helpful to avoid mis-specification. As a result, the ECM is estimated in the first differencing form with up to six lags. The short-run dynamics presents in the specific form as:

$$\Delta \ln rm_t = \beta_0 + \sum_{i=1}^{6} \beta_{1i} \Delta \ln rm_{t-i} + \sum_{i=1}^{6} (\beta_{2i} \Delta \ln rgdp_{t-i+1} + \beta_{3i} \Delta \ln cpi_{t-i+1} + \beta_{4i} \ln er_{t-i+1} + \beta_{5i} iusd_{t-i+1} + \beta_{6i} ikip_{t-i+1}) + \gamma_1 EC_{t-1} + \varepsilon_t \qquad (16)$$

The error-correction term can be derived from the long-run equation as:

$$EC_{t-1} = \ln rm_t - \beta_0 - \beta_1 \ln rgdp_{t-1} - \beta_2 \ln cpi_{t-1} - \beta_3 \ln er_{t-1} - \beta_4 iusd_{t-1} - \beta_5 ikip_{t-1} \qquad (17)$$

OLS estimation is applied for this two-step error correction model in order to draw a relationship between money demand and its fac-

tors. The short run dynamic models including narrow money demand, broad money demand functions both in Kip and foreign currency have a sensible statistic test. All coefficients are significant and reasonable explaining the model by approximately 45-60 percent. Durbin-Watson statistic interprets the overall model serially uncorrelated. However, not all signs are intuitive and plausible.

Therefore, the model is examined for its adequacy. It also looks for remedies such as if an important variable has been omitted or the wrong function form has been used. To determine whether model inadequacy results from one or more of these problems, various methods to test residual performances are used. The results of the diagnostic test suggest that the error term fulfills the classical assumptions, except for model for $M2$.

On the basis of the diagnostic tests, the short run dynamic model of money demand provides the validity of outcomes, except the broad money $M2$ model with misspecification. Therefore, the following discussion does not cover $M2$ demand function.

3.3.1. Short-run money demand functions

a) Narrow money demand function

$\Delta\ln rm_{1,t}=0.03+0.36\Delta\ln rm_{1,t-1}-0.5\Delta\ln rgdp_{t-1}-0.41\Delta\ln rgdp_{t-2}+0.29\Delta\ln rerks_{t-1}-0.26\Delta\ln rerks_{t-2}-0.45EC_{t-1}$ (18)

Based on the short-run estimated results, the adjustment coefficient of error correction for long-run equilibrium shows the intuitive sign with speed of adjustment in 2.2 quarters. This

result reflects through the inertia in holding money that a 100 percent change in real narrow money demand in previous 2.2 quarters still influences the current change by around 45 percent, with regarding to the effects of the other explanatory variables.

The coefficient of is positive (0.36). This means that the demand for real narrow money will increase by 0.36% if the previous differencing in real money in $M1$ increases by 1%, given other factors are unchanged.

Even the coefficient sign of the real income is negative which is different from expectation, but it significantly affects the real money $M1$ after two quarters. This explanatory variable is included in order to ensure the model validity.

The coefficient $\Delta\ln rm_{1,t-1}$ of the real exchange rate of the Kip against the USD is 0.29 after one quarter and -0.26 after two quarters. If the negative coefficient in the second quarter reflects the higher opportunity costs of holding money, then the real money demand for $M1$ will decrease. If the Kip loses value by 1 percent in the last two quarters, then real money demand $M1$ will decline by 0.26 percent, given that other factors are constant. The first difference of the real exchange rate Kip/USD in the previous quarter with a positive coefficient is included in this model in order to maintain model validity.

b) Broad money demand function in Kip

$\Delta\ln rm_{2k,t}=0.042-0.42\Delta\ln rgdp_{t-2}-0.27\Delta riusd_{t-1}+0.37\Delta riusd_{t-2}+0.23EC_{t-1}$ (19)

Referring to the short-run estimated results, the adjustment coefficient of error correction for long-run equilibrium shows the intuitive sign with speed of adjustment in 4.3 quarters. This result reflects that through the inertia in holding money that a 100 percent changes in real broad money demand in 4.3 quarters ago still influences the current change by around 23 percent, regarding the effects of other explanatory variables.

Even the coefficient signs of real income are negative, which are different from the expectations, but it significantly affects the real money $M2$ in the Kip after two quarters. This explanatory variable is included in order to ensure the model validity.

The coefficient of real saving in the USD interest rate is -0.27, after one quarter and 0.37 after two quarters. The negative coefficient after one quarter reflects the higher opportunity costs of holding money, and so the money demand $M2$ in Kip will decrease. If the real saving USD interest rate increases by 1 percent after one quarter, real money demand $M2$ in the Kip will decline by 0.27 percent, given that other factors remain constant. The second difference of real saving in the USD interest rates in the previous quarter with a positive coefficient is included in this model in order to maintain model validity.

c) Broad money demand function in foreign currencies

$$\Delta \ln rm_{2f,t} = 0.044 - 0.36\Delta \ln rgdp_{t-1} - 0.46\Delta \ln rgdp_{t-2} - 0.77\Delta \ln cpi_{t-2} + 0.28\Delta riusd_{t-1} - 0.25EC_{t-1} \quad (20)$$

Based on the short-run estimated results, the adjustment coefficient of error correction for long-run equilibrium shows the intuitive sign with speed of adjustment in 4 quarters. This result reflects that through the inertia in holding money, that the 100 percent change in real broad money demand in 4 quarters ago still influences the current change by around 25 percent, regardless the effects of other explanatory variables.

Even the coefficient sign of the real income is negative which is different from the expectation, but it significantly affects the real money $M2$ in foreign currencies after two quarters. These explanatory variables are maintained in order to ensure the model validity.

The coefficient of expected inflation is -0.77 after two quarters. The negative coefficient shows the substitution effect of holding money by physical goods including gold, land, and houses. Consequently, the money demand $M2$ in foreign currencies will decrease. Specifically, if people expect that inflation will increase by 1 percent in the last two quarters, real money demand $M2$ in foreign currencies will decline by 0.77 percent, given the other factors are unchanged.

The coefficient of real saving USD interest rates is 0.28 after one quarter. The positive coefficient after one quarter reflects the incentive for holding foreign currencies. Consequently, the money demand $M2$ in foreign currencies will increase. If the real saving

USD interest rate increases by 1 percent after one quarter, real money demand $M2$ in foreign currencies will increase by 0.28 percent, given that other factors remain constant.

3.3.2. Long-run money demand functions

a) Narrow money demand function

$$\ln rm_{1,t}=2.34+0.81\ln rgdp_t-0.42\ln rerkb_t-0.57\ln rerks_t - 0.10 riusd_t \tag{21}$$

b) Broad money demand function in Kip

$$\ln rm_{2k,t}=3.22+0.51\ln rgdp_t-1.96\ln rerkb_t-0.4 riusd_t \tag{22}$$

c) Broad money demand function in foreign currencies

$$\ln rm_{2f,t}=8.81+0.33\ln rgdp_t - 0.97\ln cpi_{t-1} - 2.33\ln rerkb_t-0.77\ln rerks_t-2.59 rikip_t+2.6 riusd_t \tag{23}$$

The long-run relationships for rm_1, rm_{2k}, and rm_{2f} have rational economic explanations. All signs are intuitive and plausible. Demand for money in the Lao PDR has a positive relation with income. If real GDP increases by 1%, demands for rm_1, rm_{2k}, and rm_{2f} will raise by 0.81%, 0.51% and 0.33% respectively. Thus, demand for money is most affected by changes in output. The local currency, the Kip, is used mostly for transaction purposes.

The Lao demand for $M1$, $M2$ in Kip money functions show the situation of a multi-currency economy. Exchange rates, the Kip against the USD and against the Baht, have negative influences on money demand. This shows the effect of the currency substitution. Therefore, people tend to hold more foreign currencies such as USD or Baht when the local currency loses value. Exchange rate elasticity of real narrow money balances is -0.57 to Kip depreciation against the USD and -0.42 to Kip depreciation against the Baht.

In the case of broad money demand function in foreign currencies, the exchange rate coefficients of the Kip against the USD and against the Baht are -0.77 and -2.33, respectively. This means that when the Kip depreciates against the USD or the Baht by 1%, people reduce foreign currencies from their portfolio by 0.77% and 2.33%, respectively. This can be explained by the behavior of the Lao people, when the value of the Kip decreases much, the citizens expect inflation will be high. Hence, they hedge themselves by investing in real estate and gold. As a result, $M2$ in foreign currencies decline.

Capital mobility is sensible for the $M1$ and $M2$ in Kip money demand models. The real saving USD interest rate elasticity has a negative sign, -0.1 in $M1$ function and -0.4 in $M2$ in Kip function. If the real saving USD interest rate (opportunity cost of holding Kip) increases, people tend to hold less Kip balances. In the case of $M2$ in foreign currencies, the USD interest rate elasticity is 2.6 and the Kip interest rate elasticity is -2.95. Laotian people will have more incentives for holding foreign currencies if the USD interest rate increases and the Kip interest rates decrease.

Expected inflation (cpi_{t-1}) shows the impor-

tant implication to money demand in the Lao PDR. Laotian people usually reduce their money balance holding when they expect high inflation. They hedge the risk of high inflation by investing in physical assets such as gold, housing and land.

Outstanding results from money demand functions

Speed of adjustment from short-run dynamics to long-run equilibrium: $M1$ model adjusts to its long-run equilibrium relatively faster than other models by using only 2.5 quarters while the others are 4.3 and 4 quarters for $M2$ in Kip and $M2$ in foreign currencies respectively. This result reflects that the portfolio of the $M1$ model is highly liquid with a cash-based component with relatively lower opportunity costs to reallocate its portfolio.

Income is significant, taking contemporaneous effects on the money demand adjustment. Precisely, the elasticity of current money demand differencing with respect to that of GDP is at least 0.4 percent for all types of demand for money in the short-term. In the long-run relation, considering the other effects, an increase in real GDP by 1% raises demand for money by 0.81%, 0.51% and 0.33% percent for rm_1, rm_{2k}, and rm_{2f} respectively.

Other important results from the short-term ECM dynamics is that all proxies of opportunities cost have effects on the real money demand such as exchange rate depreciations, especially Kip against USD affects the real narrow money demand negatively after two quarters. Both local and foreign interest rates have significantly influenced real broad money demand in the local currency and in foreign currencies. Expected inflation rates have a negative effect on real broad money demands in foreign currencies after two quarters. These negative influences indicate a short-term substitution effect of foreign currencies or real goods for real money demand.

Opportunity cost proxies in the long-term relations, $M2$ in foreign currencies model, include all plausible explanatory variables. This reflects the Lao situations appropriately with the phenomenon of multi-currencies use which leads to currency substitution and the capital mobility effects. Expected inflation also presents a negative impact from the long period of high inflation, hence it sometimes requires people to adjust their rational attitude by enhancing macroeconomic stability for a period of time until they are confident and feel comparable.

4. Conclusion and recommendations

Demand for narrow money, broad money in Kip and board money in foreign currencies were estimated. The estimated results suggested that all demand functions are stable. Coefficient signs are suitable with theory. The study results indicate: (i) there is evidence of ample influence of the exchange rate and interest rates on money balance dynamics in the Lao PDR and this outcome is associated with a high degree of multi-currency use in the Lao PDR; (ii) expected inflation shows the effect

of high inflation episodes on money balances, especially in terms of foreign currency, even though the country has improved its macro-economic stability over recent years; and (iii) the local currency is used mostly for transaction purposes compared to that of foreign currencies .

The study of money demand for the Lao PRD gives some suggestions for BOL and the Lao government in controlling the economy and conducting monetary policy. BOL can use narrow money, broad money in Kip and board money in foreign currencies as intermediate targets of monetary policy. BOL should take into account the effects of currency substitution and the capital mobility of the Lao PDR in a multi-currency economy. BOL should use open market operations frequently in controlling the money supply since it is the most effective tool in conducting monetary policy in the world. BOL also needs to strengthen banking supervision to make the banking sector operate more efficiently. The Lao government should stimulate the development of the financial system and by step by step de-dollarizing.

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