Khin Myo Swe[1], Si Thu Han[2]

AGGREGATE MONEY DEMAND FUNCTION IN MYANMAR: CO-INTEGRATION ANALYSIS

This empirical study is carried out to test the stability of aggregate demand function of money based on liquidity preference theory. This theory suggests that income and inflation is positively related to money supply while rate of interest has an inverse relation with it. Time series analysis was carried out for Myanmar covering the period from 1976 to 2016. The augmented Dickey-Fuller test affirmed that variables under consideration are facing unit root problem at level and are found free of this problem at first difference. A long-run relation among studied variables is confirmed by co-integration technique. The long-run estimates of the model are captured through the application of vector error correction model. The coefficients of national income, rate of interest and inflation have statistically significant impact on money demand. All the three explanatory variables have expected sign as proposed by the theory. Aggregate money demand function is in equilibrium and stability is verified. Only rate of interest has short-run relationship with money as compared to national income and inflation. These results verified the holding of liquidity preference theory in case of Myanmar.

Keywords: demand for money; national income; rate of interest; inflation; co-integration; Myanmar.

Кхін Міо Све, Сі Чу Хан

ФУНКЦІЯ ПОПИТУ НА АГРЕГАТНІ ГРОШІ В М'ЯНМІ: КОІНТЕГРАЦІЙНИХ АНАЛІЗ

Це емпіричне дослідження проводиться для перевірки стабільності функції сукупного попиту на гроші на основі теорії переваг ліквідності. Ця теорія припускає, що дохід і інфляція позитивно пов'язані з грошовою масою, в той час як процентна ставка має зворотну залежність з нею. Аналіз часових рядів був проведений для М'янми, що охоплює період з 1976 по 2016 рік. Розширений тест Дікі-Фуллера підтвердив, що розглянуті змінні стикаються з проблемою одиничного кореня на рівні і виявляються вільними від цієї проблеми при першому відмінності. Довгострокова зв'язок між досліджуваними змінними підтверджується методом спільної інтеграції. Довгострокові оцінки моделі фіксуються шляхом застосування моделі векторної корекції помилок. Коефіцієнти національного доходу, процентної ставки і інфляції надають статистично значимий вплив на попит на гроші. Всі три пояснюючі змінні мають очікуваний знак відповідно до теорії. Функція сукупного попиту на гроші перебуває в рівновазі, і стабільність перевіряється. Тільки процентна ставка має короткострокові відносини з грошима в порівнянні з національним доходом і інфляцією. Ці результати підтвердили правильність теорії переваг ліквідності в разі М'янми.

Ключові слова: попит на гроші; національний дохід; процентна ставка; інфляція; коінтеграція; М'янма.

[1] School of Economics and Trade. Hunan University. Hunan. China.
[2] School of Economics and Trade. Hunan University. Hunan. China.

Кхин Мио Све, Си Чу Хан

ФУНКЦИЯ СПРОСА НА АГРЕГАТНЫЕ ДЕНЬГИ В МЬЯНМЕ: КОИНТЕГРАЦИОННЫЙ АНАЛИЗ

Это эмпирическое исследование проводится для проверки стабильности функции совокупного спроса на деньги на основе теории предпочтений ликвидности. Эта теория предполагает, что доход и инфляция положительно связаны с денежной массой, в то время как процентная ставка имеет обратную зависимость с ней. Анализ временных рядов был проведен для Мьянмы, охватывающий период с 1976 по 2016 год. Расширенный тест Дики-Фуллера подтвердил, что рассматриваемые переменные сталкиваются с проблемой единичного корня на уровне и обнаруживаются свободными от этой проблемы при первом различии. Долгосрочная связь между изучаемыми переменными подтверждается методом совместной интеграции. Долгосрочные оценки модели фиксируются путем применения модели векторной коррекции ошибок. Коэффициенты национального дохода, процентной ставки и инфляции оказывают статистически значимое влияние на спрос на деньги. Все три объясняющие переменные имеют ожидаемый знак в соответствии с теорией. Функция совокупного спроса на деньги находится в равновесии, и стабильность проверяется. Только процентная ставка имеет краткосрочные отношения с деньгами по сравнению с национальным доходом и инфляцией. Эти результаты подтвердили правильность теории предпочтений ликвидности в случае Мьянмы.

Ключевые слова: спрос на деньги; национальный доход; процентная ставка; инфляция; коинтеграция; Мьянма

1. Introduction. Since 1950s the relation between supply of money, output and prices got a lot of attention from economists and policy makers as the effectiveness of monetary policy depends on this causal relation. Supply of money may be determined exogenously or endogenously. Variation in output and prices may be due to exogenous nature of supply of money or both these variables may be main determinants of supply of money. Advocates of the quantity theory of money propose exogenously determined supply of money while economists like Cagan (1965) states that it demonstrates both properties. It is endogenously determined in short-run due to cyclical fluctuations while it is exogenously determined in the long-run.

Money demand function has received greater attention from economists. The appropriate monetary policy is decided on its stability. It is very important to examine stability of money demand in an economy as liquidity is mainly determined by its instability. The monetary authority should target rate of interest if money demand function is unstable. When there is no question on stability of money demand function then monetary should target supply of money. It is required to opt for accurate monetary tool as large fluctuations occurs in output by selecting an inappropriate tool for monetary policy (Poole, 1970).

The liquidity preference theory is being presented by Keynes (1936). This theory postulates that there are three motives; transaction, precautionary and speculative demand for money through which money is being held. Laidler (1977) argued that speculative demand for money is the important pillar of Keynes' liquidity preference theory. This theory posits an inverse relation of rate of interest with demand for money. Furthermore, he stated that Keynes was not interested in demand for money which arises due to income and precautionary motives.

Friedman (1956) presented classical theory of money as theory of money demand. He argued that people intentionally hold money to pay for goods and services in future because of its purchasing power. He opposed the Keynesian view of money demand and stated that velocity of money is highly predictable. According to him there is no question on the stability of money demand. Thus money demand function can predict the quantity of money demanded in economy. Thus, it is very vital to analyze the money demand function for an economy.

The main objective of this paper is to examine a long-run relation between supply of money, income, rate of interest and inflation in Myanmar. It is expected that this relation is present and independent variables have expected signs with money as proposed by economic theory. Rest of paper is organized in such a way that second section explains review of literature and provides theoretical frame work for the current study. Third and Fourth sections explain research methodology and empirical results respectively. The Last section concludes the study.

2. Review of Literature. Sims (1972) developed granger causality test through which he analyzed the data on money and income for USA. The result of the study affirmed that money does granger causes income but no evidence was found that income causes money. Thus, this study supported monetarist's view that money can effect output. Following Sims, Williams, Goodhart and Gowlad (1976) used causality approach to test causal relation between money, income and prices in UK. Their study opposed the finding of Sims and uni-directional causality was witnessed from income to money. Furthermore, bi-directional causality was evidenced between money and prices in UK.

The relationship among money supply, national income, prices and rate of interest remains under extensive debate in last few decades. This debate is centered on the relative effectiveness of monetary policy for influencing the economy. However, this discussion is open and it is inconclusive till today. Sims (1972), Thornton and Batten (1985), King (1986), Stock and Watson (1989), Romer (1990) to name few, these are empirical studies which evidenced the effectiveness of monetary policy on economic activity. On the other side we have studies like Feige and Pearce (1979), Litterman and Weiss (1985), Geweke (1986), Friedman and Kuttner (1993), and Cochrane (1994) whose work supported monetary neutrality in the economy.

Lee and Li (1983) investigated the causal relation between money, prices and output in Singapore. Results of this study revealed the presence of two-way causation between money and income while one-way causation was witnessed from money to prices. In such manner, Khan and Siddiqui (1990) carried out research study for Pakistan and pointed out uni-directional causality from income to money while money and prices were having bi-directional causality between money and prices.

Nwaobi (2002) investigated the relation between money, output, inflation and rate of interest for Nigerian economy. This study covered time period from 1960 to 1995. Unit root test and Johansen and Juselius technique was applied for non-stationarity problem and for co-integration respectively. Results of this study revealed that variables of the study are co-integrated. Similarly, Anoruo (2002) also applied co-integration technique of Johansen and Juselius for Nigeria to examine the relation between money supply, output and rate of interest. The finding of this study con-

firmed the long-run relation among these variables. This study found that money demand function is stable in Nigerian economy as suggested by stability test.

Owoye and Onafowora (2004) carried out study to examine stability of demand for money in Nigeria. Quarterly data from 1986:1 to 2001:4 was analyzed through co-integration test and vector error correction model. Their study documented a long run relation between money supply, real income, domestic and foreign rate of interest, inflation and expected exchange rate. The CUSUM and CUSUMSQ tests showed stability of the money demand in Nigeria.

Abbas and Husain (2006) conducted their study to determine causal relation between money, income and prices. They analyzed time series data for Pakistan. The purpose of their study was to find long-run relation between money, prices and output. This relation between these variables was witnessed through the application of co-integration technique. Vector error correction model and granger causality found unidirectional causality in long-run which runs from income to money. Two-way causation was found between money and prices but the causal effect of supply of money on prices was greater than causal effect of prices on money supply.

Qayyum (2006) examined the relation between inflation, money and economic growth demand for Pakistan. Data on these variables was considered from 1960 to 2005. He concluded that correlation analysis confirmed a strong relation between inflation and money growth and recommended that a tight monetary policy may be adopted to curb inflation in Pakistan.

Omotor (2010) examined money demand function in Nigeria. Bound test for co-integration was applied for the data covering the time period from 1970 to 2006. Money demand is found stable and have long run relation with real income, rate of interest, exchange rate and inflation. All the coefficients of independent variables were according to economic theory.

Arize and Nam (2012) analyzed quarterly data from 1973-1 to 2009-4 for selected seven Asian countries. Their results documented that exchange rate has positive effect on money demand and rate of interest is negatively related to it. They concluded that broad money could play an important tool for monetary authorities to get the desired objectives. Similarly, Nyong (2014) examined the stability of the money demand function for the Gambian economy by analyzing quarterly data span over period of time from 1986:Q1 to 2012: Q4. This study concluded that the money demand function is not only unstable in the long run but in the short run as well.

Ahad (2015) conducted study to examine the money demand function for Pakistani economy. Time series data spanned over period from 1972 to 2012. In this study, the researcher applied Johansen cointebgration and Bayer-Hanck combined cointegration technique to determine the long run relationship between money demand, income and exchange rate along with industrial production and financial development. In a study conducted by Тьмтьrk (2017), for the Turkish economy, found out that the money demand function is stable in the said economy. Thus, this study recommended that the Turkish monetary authorities should target supply of money as a monetary tool to stabilize the economy and achieve economic growth with price stability.

Akpansung and Paul (2018) checked the stability of the money demand function in Nigeria. They applied Robust Least Squares (RLS) regression method for the esti-

mation of money demand function whereas applied CUSUM and CUSUMSQ tests to determine the stability of money demand function. Results of their study showed that income has positive significant effect on money demand while interest rate and inflation have negative significant effect on money demand. However, the stability tests confirmed an unstable money demand function for the Nigerian economy.

2.1.Theoretical Frame Work: Liquidity Preference Theory. Keynes presented his liquidity preference theory which postulates that there are three motives that why people demand for money. These motives are transaction, precautionary and speculative demand for money. The first two motives, which makes preposition I, have direct relation with income while latter one, which makes preposition II, depends on rate of interest which has an inverse relation with demand for money. Aggregate demand for money based on these two prepositions can be expressed in the following equation as noted by Macesich and Tsai (1982).

$$m = y + i \qquad (1)$$

The effects of preposition I and II are captured by income (*m*) and nominal rate of interest (*i*) respectively. Rate of interest is very important to transmission mechanism in an economy as it is the opportunity of holding money or borrowing. It can be assumed that nominal rate of interest composes of two parts that is real rate of interest (*r*) and expected inflation (*z*) as shown in equation (2).

$$i = r + z \qquad (2)$$

Now putting the value of nominal rate of interest in equation (1) which producing an aggregate demand function for money as below:

$$m = f(y + r + z) \qquad (3)$$

Equation three can be written in a testable hypothesis as:

$$m_t = \gamma_0 + \gamma_1 y_t + \gamma_2 r_t + \gamma_3 z_t + e_t \qquad (4)$$

Where *m*, is demand for money, *y* is real national income, *r* is real rate of interest, *z* is expected inflation, *e* is the disturbance term and t is time period.

3. Materials and Methods

3.1. Data and Non-stationarity test. Data on money, real income, real rate of interest and expected inflation is been taken from World Developing Indicators (WDI) CD-room version from 1976 to 2016. Here, we need to mention such monetary related researches mostly used quarterly or monthly data for more accurate results. But we can use only yearly data because quarterly or monthly data is not available. We believe this study can be helpful for interpreting the monetary situation of Myanmar though number of observations we used are rather less but utmost available. Regression models result in spurious regression when applied to time series data with the problem of unit root or non-stationarity. Their results seem good but one can find through further investigation that these results are misleading. Value of variable in time period t depends on its own lag and error term (Wooldridge 2006). To solve the stationarity problem, we used Augmented Dickey-Fuller (ADF) test where its equation of ADF without trend would look like as:

$$v_t = \delta + \rho v_{t-1} + \sum_{i=1}^{n} \rho_j \Delta v_{t-1} + e_t \qquad (5)$$

where with the inclusion of trend it would be written in the form as:

$$v_t = \delta + \alpha_t + \rho v_{t-1} + \sum_{i=1}^{n} \rho_j \Delta v_{t-1} + e_t \qquad (6)$$

3.2. Long-Run Relation: Co-integration. Johansen and Juselius (1990) developed test to find long-run relation among variables whose are integrated of the same order. This test considered variables at difference without loosing their long-run relation and identifies that how much co-integration vectors are existed among variables. The test estimates are exactly distributed which make a foundation to apply this test for long-run relation among variables whose are being made stationary through differencing. Vector autoregressive (VAR) model will take the following form:

$$\Delta w_t = \sum_{i=1}^{n} \pi_i \Delta w_{t-i} + \vartheta w_{t-1} + \mu + e_t \qquad (7)$$

where w_t is a vector of non-stationarity variables & $i = 1, 2, 3, ..., k$

Fundamental nature of the co-efficient ϑ is that it depicts the long-run relationship among non-stationarity variables in Johansen and Juselius test. If it results in $0 < rank\ \vartheta = r < p$ then there are matrices α and β of dimension $p \times r$ where $\vartheta = \alpha\beta$ and r co-integrating relations among elements of w_t; where α and β are co-integration vectors and error correction parameters, respectively.

4. Empirical Analysis and Discussion. This study analyzed the long-run relation, to verify liquidity preference theory in case of Myanmar, between money supply (m), real income (y), real rate of interest (r) and inflation rate (z). All variables of study have been tested for unit root problem. The ADF test confirmed that these variables having problem of non-stationarity so asking for co-integration analysis. However, this problem has been eliminated by taking variables at first difference. Result of unit root analysis is shown in Table 1.

Table1. **Result of ADF Unit Root Test**

Variables	Level	First Difference	Decision
log(m)	0.5729	-4.0654[*]	I(1)
log(y)	-2.006	-5.0402[*]	I(1)
log(r)	-2.9433	-5.3942[*]	I(1)
log(z)	2.9567	-6.0754[*]	I(1)

Note: * indicates t-statistic significant at 1% based on MacKinnon (1996) one sided p-values.

The result of co-integration test of Johansen and Juselius is representing in Table 2. There is one co-integrating vector which is confirmed by Trace Statistics and Max-Eigen values at five percent level. This applied that a long-run relation among variables is present. Thus this result postulated that the aggregate money demand equation (4) is validating the liquidity preference theory.

Table 2. **Result of Johansen & Juselius Co-integration Test**

Hypothesized No. of CE(s)	Trace Statistics	Critical Value	Max-Eigen Statistic	Critical Value
None [*]	65.27455	47.85613	41.53720	27.5843
At most 1	23.73735	29.79707	15.56439	21.1316
At most 2	8.172958	15.49471	7.556929	14.2646
At most 3	0.616029	3.841466	0.616029	3.8414

Note: Trace test & Max-eigenvalue test indicates 1 co-integrating eq. at the 0.05 level. * denotes rejection of the null hypothesis at the 0.05 level.

The long-run estimates of aggregate money demand function based on vector error correction model (VECM) is presented in Table 3.

Table 3. **Long Run Estimates**

Dependent Variable: *log(m)*			
Regressors	Coefficients	Stand. Error	t-statistics
log(y)	0.290798[***]	0.14706	1.97742
log(r)	-5.549221[*]	1.03715	-5.35045
log(z)	0.732442[***]	0.37457	1.95542

Note: * and *** represents significance at 1 and 10 percent respectively.

This confirmed that aggregate money demand function is according to liquidity preference theory. All the coefficients of explanatory variables are significant at one percent level of significance. Real income and inflation are positively associated with money demand while rate of interest is having negative association with it. These estimations support the results of Anoruo (2002) and Nwaobi (2002); they carried out research studies for Nigeria. Similarly, these results are in accordance with the findings of Emerson (2006) who conducted his study for USA and this study contradicts like Emerson (2006) the findings of Miyao (1996) who also carried study for USA.

Short run estimates obtained through the error correction model are given in Table 4. Inflation is the only variable that has negative and significant effect on money compare to other two explanatory variables. Thus, in the short run peoples are demand less as inflation is increasing compare to long run. Moreover, the coefficient of ECT is negative and significant that suggests that model is in equilibrium and the model will correct itself from any external shock within five years.

Table 4. **Short Run Estimates**

Dependent Variable: Δ*log(m)*			
Regressors	Coefficients	Stand. Error	t-statistics
Δ*log(y)*	0.056068	0.448129	0.125117
Δ*log(r)*	-0.008670	0.088077	-0.098435
Δ*log(z)*	-0.331996***	0.178747	-1.857351
ECT(-1)	-0.212875***	0.113620	-1.873571

Note: * represents significance at 10 percent level.

The error correction model is checked for several econometric problems like serial correlation, hetroskedasticity, normality and autoregressive conditional het-

roskedasticity (ARCH). Results of these diagnostic tests are presented in Table 5. Similarly, stability of the model is checked through Cumulative sum of recursive residual (CUSUM) and cumulative sum of squares of recursive residual (CUSUMQ) techniques based on error correction model.

Table 5. **Results of Diagnostic Tests**

Test	Tests statistics	Probability
Autocorrelation	19.12	0.26
Hetroskedasticity	7.36	0.59
Normality	0.82	0.66
ARCH	0.27	0.60

Figures 1 and 2 represent stability test. Critical bounds at 5% level of significance are represented by straight lines in both Figures 1 and 2. All coefficients in error correction model substantiated stability as plots of both CUSUM and CUSUMQ statistics are within the critical bounds.
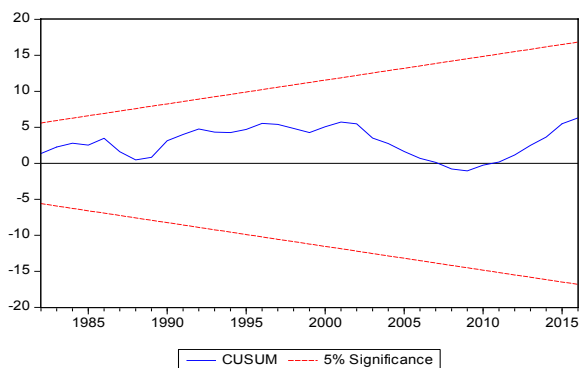
Figure 1. **Cumulative Sum of Recursive Residual**
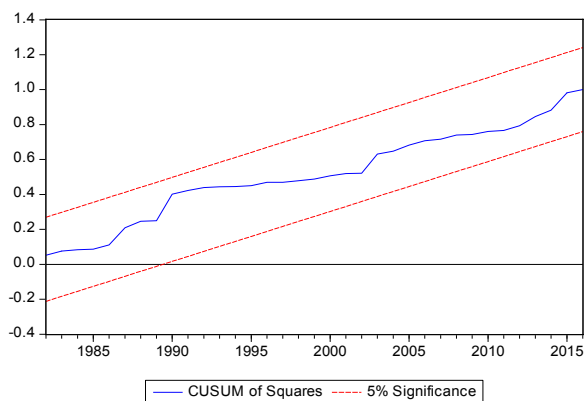
Figure 2. **Cumulative Sum of Squares of Recursive Residual**

Short run and long run causal relation results are given in Table 6. The short run causality results are provided in column second to column fifth while last column of the Table represents long run causality. The short run causality results indicate a feedback effect between money and income, money and interest rate, and between money and inflation. Similarly, bidirectional causality is present between income and interest rate, between income and inflation, between interest rate and inflation. The long run causality results indicate bidirectional causality between money and income, between money and interest rate and between income and interest rate. Moreover, unidirectional causality is running from inflation to money, from inflation to income and interest rate.

Table 6. **Causality Estimates Based on VECM**

Endogenous Variable	Short Causality (F-stat.)				ECT (t-stat.)
	$\Delta log(m)$	$\Delta log(y)$	$\Delta log(r)$	$\Delta log(z)$	
$\Delta log(m)$	---	6.03[*]	5.75[*]	7.64[*]	-3.04[*]
$\Delta log(y)$	25.73[*]	---	29.30[*]	26.66[*]	-1.89[***]
$\Delta log(r)$	2.80[***]	3.34[**]	---	4.74[*]	-2.29[**]
$\Delta log(z)$	7.63[*]	6.09[*]	5.60[*]	---	1.34

Note: Note: *, ** and *** represents significance at 1, 5 and 10 percent respectively.

5. Conclusions. This empirical study is performed to examine the validity of liquidity preference theory in Myanmar. Time series data on money, real income, real rate of interest and inflation was investigated for period 1976 to 2016. Data on all series was checked for non-stationarity problem trough ADF test. Stationary of all variables was achieved at first difference. Aggregate money demand function was tested for co-integration and one co-integration vector was confirmed by Johansen and Juselius method. Thus, a long-run relation was affirmed between the studied variables. Real income and inflation were having positive association with aggregate money while inverse relation was witnessed for rate of interest. Coefficients of these variables are statistically significant and are in accordance with the liquidity preference theory.

The causality results showed that unidirectional causality is found from inflation to money demand thus; the monetary authorities in Myanmar can use money supply as a tool to stabilize the economy.

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