An Investigation into the Sensitivity of Money Demand to Interest Rates in the Philippines

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Studies into the effect of interest rates on money demand have been done on various emerging markets. This paper aims to look at the relationship between money demand and interest rates in the Philippines. An error correction model is estimated to see the effects of output and interest rates on money demand. The results show that the coefficients for 91-day Treasury Bill rates are negative and insignificant. However, the coefficients for 364-day Treasury Bill rates are negative and significant suggesting that they may be better predictors of money demand as opposed to 91-day rates.

INTRODUCTION

This project delves into the sensitivity of money demand to interest rates in the Philippine setting.

What relationship can we ascertain from the two and what is this relationship's effect on the economy?

The money market is a vital component of most theories that explain economic progress. Having an accurate understanding of this market is important both to the analysis of past monetary policies and to the formulation of present and future policies. This paper will focus on the demand side of the money market. Examining the nature of money demand is needed in order to create more accurate forecasting models. The objective of this paper is to try to see if a relationship exists between money demand and interest rates in the Philippines. This is one of the key relationships in macroeconomic theory. The paper thus intends to examine the nature of the money demand function in the country. There has been little work done to see if the theories put forth by Friedman (1959) and Laidler (1966b) are applicable in the Philippines and thus this paper will try to find that out.

REVIEW OF RELATED LITERATURE

There is a large number of studies that have tackled the role of income and interest rates in determining the stock of desired money balances or demand for money. Friedman (1959) tried to reconcile the discrepancy between secular and cyclical behavior of the velocity of circulation of money by applying the theory of consumption behavior. He developed a hypothesis that explains the procyclical pattern of velocity. In Friedman's theory, both consumer expenditures and the demand for money depend not on current income but on permanent income, or long-run average income. Thus, in the second half of a cyclical upswing, when current income or GDP exceeds permanent income or GDP, the demand for money does not keep pace with current GDP; thus velocity (GDP/M) rises. During a recession, actual GDP or income falls below permanent or "normal" levels. Again, because the demand for money depends on permanent income, the quantity of money demanded does not decline in proportion to the decline in actual GDP; velocity (GDP/M) falls.

Laidler (1966a) used permanent income as the explanatory variable for the demand for money. The definition of money used in the study includes and excludes time deposits. In this paper, permanent income is regarded as a proxy for the sum of human and non-human wealth, so it is assumed that it is related to the total size of the wealth portfolio. In another paper, Laidler (1966b) attempted to investigate the nature of the demand function for money and the role of interest rate in this function. The goal of this study was to determine if the demand for money is more closely related to long-term or short-term interest rates and also to find out if there is some evidence that the liquidity trap did exist during the period of the study.

Goldfeld (1973) found out that a conventional formulation of the money demand function could be sturdy however scrutinized. Such a function gives sensible interest and income elasticities. The conventional equation shows no marked instabilities in both the short and long run. Finally, the equation gives us a reasonable speed of adjustment to changes in income or interest rates.

However, Goldfeld (1976) raised the question over the case of the missing money. He noticed that when money demand functions that successfully explained pre-1974 data were used to explain post-1974, they constantly overpredict actual money demand. His paper was able to pinpoint the business sector as the prime source of the puzzle however he wasn't able to come up with a money demand function that can explain the shortfall in money demand.

Heller and Khan (1979) introduced an improved demand-for-money function which takes into account the entire spectrum of relevant opportunity costs on alternative financial assets. Garcia and Pak (1979) suggested that a lot of the missing money may be located in the federal funds market and among other technological developments in the money market. Cooley and LeRoy (1981) were not persuaded by attempts to create a money demand equation but they themselves were unable to offer an attractive alternative. They discussed the weaknesses of the results of these studies based on their research reporting biases and identification problems.

Montes (1981) was able to successfully demonstrate truncation bias in household money demand and he used several interest rates in his money demand function. Among those rates, only the interest rate on demand deposits proved to be significant.

Judd and Scadding (1982) suggested that innovations in financial agreements caused the instability in the demand for money after 1973. They also found out that it was impossible to distinguish empirically the competing hypotheses about money demand using the pre-1973 data. Reopening the pre-1973 agenda of empirical issues was unable to explain the instability and was also unable to explain the ambiguities in the pre-1973 literature. None of the alternative specifications appeared to be superior to the Goldfeld equation in significantly reducing the latter's post-1973 overpredictions except possibly Hamburger's specification. They implied that the post-1973 work on money demand has made more progress in explaining past shifts than it has in producing formulations that will be able to predict future shifts. They also said that monetary instability may be less acute than it has been in the recent past to the extent that monetary policy can bring down inflation permanently. It appears that excessive money growth is the main source of money demand instability and not financial innovations. They also stated that reverting to interest rate targeting for short-run stabilization would not be useful.

There have been some recent articles that examined the relationship between money demand and interest rates in emerging markets. Using data from the Dominican Republic, Carruth and Sanchez-Fung (2000) found a negative relationship between real money balances and a US long-run interest rate, and a positive relationship between real money balances and the real exchange rate vis-a-vis the USA. Hossain and Yunus (2009) found a well behaved and stable money demand function in Bangladesh. Their study found that money demand is sensitive especially to 182-day Treasury Bill rates. Diagne (2010) found evidence of a long-run stationary relationship between M1 velocity, output and French Treasury Bill rates in Senegal. Bashier and Dahlan (2011) found that in Jordan, there is a positive relationship between money aggregates and income and there is a negative relationship between money aggregates and either the interest rate or exchange rate depreciation. Lastly, Saglam Celikoz and Arslan (2011) found that in

Turkey, gross domestic product has a positive and significant effect on money demand while the inflation rate, exchange rate and and interest rate volatility on time deposits all have a negative and significant effect on money demand.

Finally, Canlas (1986) found out that unanticipated money has non-neutral effects on output while anticipated money has neutral effects, that when private credit is held constant, currency exerts a negative effect on output and that credit is insignificant.

THE MODEL

The model I shall use is based on the work of Laidler (1966b). In his study, the demand equation for money balances may be written as

$$M_d = f\,(Y_p, r) \tag{1}$$

where M_d is the demand for money, Y_p is permanent income and r is the rate of interest. Laidler's framework claims that money demand is a function of permanent income and interest rates. To estimate the effect of real income and real interest rates on real money balances we introduce P which represents the price level. Equation 1 thus becomes

$$M_d/P = f\,(Y_p, r) \tag{2}$$

Taking semi-logarithms of Equation 2 yields:

$$(m - p) = \beta_1 y + \beta_2 R \tag{3}$$

where lower case letters denote natural logarithms. Equation 3 assumes log-linearity in money, prices, and incomes, and linearity in interest rates (Carruth & Sanchez-Fung, 2000). The general result we are interested in estimating will result in the equation shown below

$$(m - p) = \beta_1 + \beta_2 y + \beta_3 R + \mu, \tag{4}$$

where $(m - p)$ is our dependent variable. The independent variables are y and R while μ represents the error term.

Ordinary least squares (OLS) will be used in estimating the function. Multiple regression analysis will be used to obtain the results. We shall use two alternative measures of money stock to look at the effect of interest rates on money demand. Both M1 and M2 will be used to represent m and we shall determine which of the two has the better fit. Two interest rates will be used to represent R. The 91-day Treasury Bill rate will represent the short rate while the 364-day T-bill rate will represent the long rate. We shall try to see which of these two rates can explain money demand movements better. The natural logarithm of real gross domestic product (GDP) will be used as to represent y while the natural logarithm of the Consumer Price Index (CPI) represents p.

DATA

Though most of the previous studies conducted suggest that the short-term rate is more appropriate to use as the determinant of the demand for money, I still would like to test the demand for money function using the rate of return on the 364-day Treasury Bill and of course the rate of return on the 91-day Treasury Bill.

This paper uses both M1 and M2 definitions of money. M1 or the narrow definition of money includes currency in circulation and peso demand deposits. M2, or the broad definition of money, consists of M1 plus peso savings deposits and peso time deposits.

Quarterly data on M1, M2, real GDP, CPI and 91-day and 364-day Treasury Bill rates covering the first quarter of 1994 up to the third quarter of 2015 were obtained from the Key Statistical Indicators website of the *Bangko Sentral ng Pilipinas* (Central Bank of the Philippines).

ESTIMATION AND RESULTS

I will estimate four specifications of the model. The four specifications are listed below. Specifications (1) and (2) have $(m1 - p)$ as the dependent variable which is the natural logarithm of M1 minus the natural logarithm of the CPI. Specifications (3) and (4) have $(m2 - p)$ as the dependent variable which is the natural logarithm of M2 minus the natural logarithm of the CPI. Specifications (1) and (3) have the variable *91D*, which is the 91-day Treasury Bill rate representing *R*. Finally, specifications (2) and (4) have the variable *364D*, which is the 364-day Treasury Bill rate representing *R*.

Specification (1): $(m1 - p) = \beta_1 + \beta_2 y + \beta_3 91D + \mu$

Specification (2): $(m2 - p) = \beta_1 + \beta_2 y + \beta_3 364D + \mu$

Specification (3): $(m2 - p) = \beta_1 + \beta_2 y + \beta_3 91D + \mu$

Specification (4): $(m2 - p) = \beta_1 + \beta_2 y + \beta_3 364D + \mu$

Nelson and Plosser (1982) show that the macroeconomic time series data often exhibit a unit root process and are not stationary. Results that are based on nonstationary data produce spurious results. Therefore, time series data should be tested for stationarity. I test for the stationarity of my variables by using the augmented Dickey-Fuller test. The equation for this test is

$$\Delta X_t = \alpha + \rho_t + \beta X_{t-1} + \sum_{i=1}^{n} \lambda_i \, \Delta X_{t-1} + \varepsilon_t \tag{5}$$

In this equation, *X* is the variable under consideration, Δ is the first difference operator, *t* is a time trend, and ε is a stationary random error term. Table 1 gives us the results of the augmented Dickey Fuller test for unit roots. The results show that *y*, $(m1 - p)$ and $(m2 - p)$ are not stationary at level form while *91D* and *364D* are stationary at level form. All variables are stationary in first difference form.

TABLE 1
UNIT ROOT TEST

Variable	Level	First Difference
y	-1.1672	-4.6579***
91D	-4.6367***	-10.1075***
364D	-4.3587***	-5.61201***
(m1 – p)	-1.5954	-3.8388**
(m2 – p)	-2.5167	-3.4402**

**Significant at the 5% level
***Significant at the 1% level

Since the variables are found to be first order integrated, Johansen's (1990) cointegration test is conducted to test the long run relationship among the variables in the model. This step is conducted before estimating the model in the first difference form. This test result is presented in Tables 2 and 3. The p-values in Tables 2 and 3 suggest that the null hypothesis of no cointegration is rejected for all four specifications. Since the hypothesis of no cointegration is rejected, an error correction model is based on the model of Engle and Granger (1987) is developed.

$$\Delta(m - p) = \beta_1 + \beta_2 \Delta y + \beta_3 \Delta R + \beta_4 EC_{t-1} + v, \tag{6}$$

In equation (6), EC_{t-1} is the error correction term, or the lag of the estimated error term from equation (4) and *v* is the random error term. The estimated results are listed in Table 4.

TABLE 2
JOHANSEN'S COINTEGRATION TEST FOR SPECIFICATIONS 1 AND 2

		(1)			(2)	
H_0	Eigenvalue	Trace test	p-value	Eigenvalue	Trace test	p-value
$r = 0$	0.3892	52.639	0.0000	0.4636	64.692	0.0000
$r \leq 1$	0.1132	11.727	0.1726	0.1139	12.998	0.1150
$r \leq 2$	0.0210	1.7573	0.1850	0.0350	2.9600	0.0853

TABLE 3
JOHANSEN'S COINTEGRATION TEST FOR SPECIFICATIONS 3 AND 4

		(3)			(4)	
H_0	Eigenvalue	Trace test	p-value	Eigenvalue	Trace test	p-value
$r = 0$	0.4144	56.345	0.0000	0.4674	66.079	0.0000
$r \leq 1$	0.1126	11.932	0.1619	0.1159	13.798	0.0880
$r \leq 2$	0.0240	2.0145	0.1558	0.0422	3.5763	0.0586

TABLE 4
ERROR CORRECTION MODEL ESTIMATION RESULTS

	Dependent variable $\Delta(m1 - p)$		Dependent variable $\Delta(m2 - p)$	
Coefficients standard errors in ( )	(1)	(2)	(3)	(4)
Constant	0.0129***	0.0126***	0.0146***	0.0140***
	(0.0045)	(0.0044)	(0.0038)	(0.0038)
Δy	0.7458***	0.7470***	0.4821***	0.5136*
	(0.0578)	(0.0559)	(0.0470)	(0.0497)
$\Delta 91D$	−0.0041		−0.0019	
	(0.0029)		(0.0024)	
$\Delta 364D$		−0.0058*		−0.0048***
		(0.0030)		(0.0026)
EC_{t-1}	−0.4030***	−0.4076***	−0.2308***	−0.1382***
	(0.0654)	(0.0643)	(0.0462)	(0.0292)
Diagnostics p-values in ( )				
Adjusted R^2	0.6638	0.6744	0.5572	0.5505
Durbin-Watson	1.8336	1.8650	1.8369	1.9880
	(0.2280)	(0.2697)	(0.2241)	(0.4699)
F	56.9371	59.6887	36.6514	35.6964
	(5.39e-20)	(1.46e-20)	(3.99e-15)	(7.35e-15)
Breusch-Pagan	3.1323	4.30225	2.144255	1.7570
	(0.3717)	(0.2306)	(0.5430)	(0.6243)

*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

The results show the expected signs for Δy, $\Delta 91D$, $\Delta 364D$ and ΔEC_{t-1}. Output (y) is positive and significant at the 1% level for all four specifications. The error correction term $\Delta EC_{t-1}$is negative and significant at the 1% level for all four specifications. $\Delta 91D$ is negative but not significant in specification (1) and (3). However, $\Delta 364D$ is negative and significant at the 10% level for specification (2) and (4). The p-values of the F-statistic for all four specifications are low meaning that the four specifications are significant. The p-values of the Durbin-Watson statistic for all four specifications are relatively high suggesting that we fail to reject the null hypothesis of no serial correlation. The p-values of the Breusch-

Pagan test are relatively high for all four specifications meaning that we fail to reject the null hypothesis of homoscedasticity.

CONCLUSION

This paper attempted to create a money demand model for the Philippines. Due to the nature of time series data, the variables were tested for unit roots. Some variables were found to be nonstationary. A cointegration test was then used to test the long run relationship of the variables. At least one cointegrating vector was found. This enabled an error correction model to be created. The paper's results have shown that interest rates have some impact on money demand in the Philippines. The 364-day Treasury Bill rate has a significant effect on money demand while the 91-day Treasury Bill rate proved to be not significant.

The money demand function is a vital component of establishing monetary policy. Because of this a lot of research has been done on money demand functions. It is therefore important that we determine a function appropriate for the Philippine setting. It is hoped that this paper would be a catalyst in furthering discussion about money demand functions as well as add to the body of knowledge in the field of monetary economics.

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