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MONETARY UNCERTAINTY AND DEMAND FOR MONEY IN KOREA

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ABSTRACT

Friedman's volatility hypothesis asserts that increased volatility of money supply can lower the velocity of money or increase the demand for money. Previous studies have tested this hypothesis by using data from a few industrialized countries. In this paper, we estimate the demand for money in Korea after including a measure of volatility of nominal money supply. We provide support for Friedman's hypothesis in the short run as well as in the long run.

JEL Classification: F40

1. INTRODUCTION

The Milton Friedman volatility hypothesis refers to the fact that the volatility in monetary growth leads to a decline in velocity or an increase in the demand for money. The hypothesis is the result of a switch in monetary policy of fixing interest rates to controlling the monetary aggregates by the Fed, which took place in 1979. Because of this switch, the velocity of money declined in the post-1979 period and many interpreted this as failure of monetarism. Milton Friedman (1984), however, argued for money growth volatility as a source of the decline in velocity. Indeed, using U.S. data, Hall and Noble (1987) tested this hypothesis when they showed that volatility of the monetary growth Granger caused growth of velocity.

Most researchers, however, have tested the hypothesis using an alternative approach. Since a decline in velocity implies an increase in holding cash balances, one could easily test the hypothesis that increased volatility in money growth causes an increase in the demand for money. Indeed, Friedman (1984) argued that exceptional volatility of monetary growth increases the degree of perceived uncertainty and thereby increases the demand for money. Therefore, under this approach, researchers have included a measure of volatility of money growth as a determinant of the demand for money in addition to standard variables, such as income and interest rate. A significantly positive coefficient obtained for the volatility measure will support Friedman's hypothesis. The list includes only a limited number of studies, i.e., Choi and Oh (2003) who tested the hypothesis for the U.S. and showed that monetary uncertainty reduced the demand for money in the U.S. A similar conclusion was reached by Bruggemann and Nautz (1997) who tested the hypothesis using data from unified Germany.

More recent studies, however, tried to distinguish the short-run effects of monetary uncertainty from its long-run effects. As such, Bahmani-Oskooee and Xi (2011) consider the demand for money in Australia and show that monetary uncertainty has only short-run effects on the demand for money in Australia and not the long-run effects. Similarly, when Bahmani-Oskooee *et al.* (2012) tested the hypothesis using Chinese data, they found that monetary uncertainty had only short-run positive effects on the demand for money in China that did not last into the long run.

In this chapter we try to expand the literature on Friedman's hypothesis by considering the demand for money in Korea. To that end we briefly review studies pertaining to the demand for money in Korea and introduce the model and the method in Section II. Empirical results in support of Friedman's volatility hypothesis are reported in Section III. Finally, Section IV concludes. Data definition and sources are cited in the Appendix.

2. THE MONEY DEMAND FUNCTION AND ESTIMATION METHOD

The main determinants of the demand for money in any country are said to be a scale variable such as real GDP and a measure of opportunity cost, the interest rate. Korean demand for money is no exception. More recent studies, however, have also included the exchange rate as another determinant to account for some degree of currency substitution. A depreciation of domestic currency or an appreciation of foreign currency increases the domestic currency value of foreign assets held by domestic residents. If domestic residents consider this to be an increase in their wealth, clearly they will increase their spending, hence their demand for domestic currency. Indeed, Bahmani-Oskooee and Rhee (1994), who employed Engle-Granger cointegration technique to estimate the Korean demand for money, showed that in Korea, while M1 monetary aggregate is cointegrated with its determinants, M2 is not. However, when Lee and Chung (1995) employed the Johansen-Juselius cointegration technique they reversed Bahmani-Oskooee and Rhee (1994) results and concluded that "a stable long-run relationship exists for M2, but not M1" (Lee and Chung, 1995). Both studies interpreted the existence of a cointegrating vector as a sign of s stable long-run relationship between money and its determinants.

However, Bahmani-Oskooee and Bohl (2000) who estimated the demand for money for the unified Germany showed that cointegration among a set of variables does not necessarily imply a stable function. One must apply statistical tests for the stability of long-run as well as short-run estimated elasticities to determine whether they are stable over time. Following this argument, Bahmani-Oskooee and Shin (2002) reconsidered the Korean demand for money one more time. They estimated a money demand function using all three monetary aggregates one by one, i.e., M1, M2, and M3 measures. Although they were cointegrated with their determinants, the application of CUSUM and CUSUMSQ tests to the residuals of each error-correction model revealed that regardless of which measure of monetary aggregate was used the Korean money demand is unstable.

We adopt the same specification as the above studies and add a measure of monetary uncertainty as another determinant of the demand for money in Korea. Thus, the long-run demand for money takes the following form:

$$LnM_t = a + bLnY_t + cLnr_t + dLnNEX + eLnV + \varepsilon_t \qquad (1)$$

where M is the real M2 monetary aggregate, Y is the real GDP, r is an interest rate, NEX is the nominal exchange rate, and V measures the volatility of nominal money stock, M2. Following the literature, while we expect an estimate of b to be positive and an estimate of c to be negative, an estimate of d could be positive or negative. Since the nominal exchange rate is defined as the nominal effective exchange rate, a decline reflects a depreciation of the Korean won, or an appreciation of foreign currencies. As mentioned before, an appreciation of foreign currencies increases the domestic currency value of foreign assets held by Koreans. Assuming the wealth effect, an estimate of d is expected to be negative (Arango and Ishaq Nadiri, 1981). However, as argued by Bahmani-Oskooee and Pourheydarian (1990) if there is an expectation of further appreciation of a foreign currency, the public may hold more foreign currency and less domestic currency, implying a positive estimate of d. Finally, if Friedman's volatility hypothesis is to receive support, an estimate of e is expected to be positive.

Previous studies have shown that in order to properly test for stability of the long-run coefficient estimates of equation (1), we should include the short-run dynamic adjustment mechanism. The procedure basically amounts to specifying (1) in an error-correction modeling format. Thus, following Pesaran *et al.* (2001) bounds testing approach we rely upon equation (2):[1]

$$\Delta LnM_t = \alpha + \sum_{i=1}^{n1} \beta_i \Delta LnM_{t-i} + \sum_{i=0}^{n2} \delta_i \Delta LnY_{t-i} + \sum_{i=0}^{n3} \phi_i Lnr_{t-i} + \sum_{i=0}^{n4} \tau_i LnNEX_{t-i} + \sum_{i=0}^{n5} \mu_i \Delta LnV_{t-i}$$

$$+ \rho_0 LnM_{t-1} + \rho_1 LnY_{t-1} + \rho_2 Lnr_{t-1} + \rho_3 LnNEX_{t-1} + \rho_4 LnV_{t-1} + \varepsilon_t \qquad (2)$$

Equation (2) is an error-correction model in which Pesaran *et al.* (2001) replace the lagged error-term with the linear combination of lagged level variables.[2] The main advantage of this specification over the others is that the short-run effects and the long-run effects are inferred in one step by estimating (2). The short-run effects are reflected in the estimates of the coefficients attached to the first differenced variables. The long-run effects are judged by the estimates of ρ_1-ρ_4 normalized on ρ_0. However, in order to avoid spurious long-run coefficients, we must establish cointegration among the variables. Pesaran *et al.* (2001) propose the familiar F test for joint significance of lagged level variables as a sign of cointegration. However, they also tabulate new critical value for the test which accounts for the integrating properties of the variables. They show that their upper bound critical value could be used when some variables are I(0) and some I(1) which is a common property of time series variables. Hence there is no need for pre unit root testing under this method.[3]

3. THE RESULTS

The error-correction model (2) is estimated using annual data over the period 1971-2010 from Korea. The exact definition of each variable and the sources of data are provided in the Appendix. Since the data are annual, following the literature, we impose a maximum of four lags on each variable and estimate all possible lag combinations. We then use the AIC criterion to select the optimum number of lags, or the optimum model. Results from the optimum model are reported in Table 1.

Due to the volume of the results, we report them in three separate panels. From the short-run results, reported in Panel A, we gather that all variables carry at least one significant short-run coefficient, except income. Clearly, the volatility of money has short-run effects on the demand for money in Korea. Do these short-run effects last into the long run? To answer this question, we shift to Panel B. All variables do carry their expected signs and they are all significant, except income. The fact that the nominal effective exchange rate carries a significantly negative coefficient implies that as the Korean won depreciates, Koreans increase their demand for domestic currency. This supports the wealth effect that was discussed in the previous section. More importantly, it appears that volatility of money has a significantly positive effect on money demand in Korea, supporting Friedman's volatility hypothesis. However, in order for the long-run estimates not to be spurious, we must establish cointegration among all variables. The results of the F test along with a few other diagnostics are reported in Panel C.

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[1] The methodology here closely follows Bahmani-Oskooee *et al.* (2008).

[2] The two are indeed equal. This could be seen by lagging all terms in (1) by one period and solving it for the lagged error term.

[3] A variable is said to be integrated of order d if it achieves stationarity after being differenced d times. Thus, an I(0) variable is a stationary variable. For other applications of this method, see Bahmani-Oskooee, and Hegerty (2007) ; Halicioglu (2007) ; Narayan *et al.* (2007). ; Tang (2007) ; Mohammadi and Cak (2008). ; Wong and Tang (2008). ; De Vita and Kyaw (2008) ; Payne (2008) ; Bahmani-Oskooee and Gelan (2009) ; and Chen and Chen (2012).

Table-1. Full-Information Estimate of Equation (2).

Panel A: Short-Run Coefficient Estimates

	Lag Order					
	0	1	2	3	4	5
Δ Ln M	-	1.2814 (4.49)	1.0286 (4.67)	0.8324 (4.66)		
Δ Ln Y	0.3696 (0.50)					
ΔLn r	-0.5951 (1.29)	2.6663 (5.05)	1.8328 (4.11)	1.8436 (4.42)		
Δ Ln NEX	0.2489 (0.28)	2.2649 (1.81)				
Δ Ln V	-0.278 (1.37)	-1.599 (3.95)	-0.9671 (3.60)	-1.2681 (6.02)		

Panel B: Long-Run Coefficient Estimates

Constant	*Ln Y*	*Ln r*	*Ln NEX*	*Ln V*
17.426 (3.54)	0.7202 (0.52)	-0.5726 (9.21)	-2.1339 (2.79)	0.7202 (4.87)

Panel C: Diagnostic Statistics

F	ECM_{t-1}	*LM*	RESET	*Adj.* R^2
13.74	-1.9645 (6.04)	0.08	0.02	0.84

Notes: a. Number inside parentheses are absolute value of t-ratios.

b. The upper bound critical value of the F statistic at the usual 5% level of significance is 4.01. This comes from Pesaran *et al.* (2001), Table CI-Case III, p. 300).

c. LM is the Lagrange multiplier test for serial correlation. It has a χ^2 distribution with 1 degree of freedom. The critical value at the 5% level of significance is 3.84.

d. RESET is Ramsey's test for functional form. It is also distributed as $\chi^2_{(1)}$.

Clearly, our calculated F statistic of 13.74 for joint significance of lagged level variables, or cointegration, is much larger than the upper bound critical value of 4.01, supporting cointegration. Next, using the long-run coefficient estimates from Panel A and equation (1) we form an error-correction term, say, *ECM*. After replacing the linear combination of the lagged level variables by ECM_{t-1}, we estimate equation (2) one more time. A significantly negative coefficient obtained for ECM_{t-1}reflects the fact that variables are adjusting toward their long-run equilibrium values, as is the case from Panel C. The size of the coefficient signifies the speed of adjustment. Since the data are annual, our estimate of 1.96 indicates that 98% of the adjustment takes place in six months.

Two other statistics are also reported. The Lagrange Multiplier (LM) and Ramsey's RESET test. The first is used to assess the serial correlation and the second one is used to judge misspecification. They are both distributed as χ^2 with one degree of freedom. Since our calculated statistics are both much less than the critical value of 3.84, residuals are not serially correlated and the model (2) is not misspecified

Finally, to test for the stability of the short-run and long-run coefficients, following the literature (e.g., Bahmani-Oskooee *et al.* (2005), we apply the well-known CUSUM and

CUSUMSQ tests to the residuals of equation (2). These tests are proposed by Brown *et al.* (1975) and they require that we break the sample in such a way that there are enough observations before and after the break point. By moving one observation from one period to the other, the two statistics are re-calculated and then plotted against the break points, or break dates. The plot of these statistics should stay within the 5% significance level if all coefficients are to be stable. Since critical values change when the break point changes, they are portrayed by two straight lines, whose equations are given in Brown *et al.* (1975). Figure 1 depicts the graphical presentation of these tests. As can be seen our estimated coefficients are stable. Thus, it appears that including a measure of monetary uncertainty into the money demand specification in Korea yields a stable demand for money.
Figure 1 goes here

4. SUMMARY AND CONCLUSION

Monetary uncertainty measured by the volatility of nominal money supply is said to make the public more cautious. This will lead to an increase in cash holding which, in turn, results in a reduced velocity of money. Since Milton Friedman argued for this, it has become known as Friedman's volatility hypothesis. Therefore, researchers have either looked at the impact of monetary uncertainty on velocity or on the demand for money. Most researchers have followed the later rout.

In this paper, we consider the impact of monetary uncertainty on the demand for money in Korea. Since previous studies could not establish the stability of the demand for money in Korea, we wonder whether including a measure of monetary uncertainty yields a stable demand for money in Korea. To that end, we rely upon a specification that includes a measure of monetary uncertainty in addition to income, interest rate and the nominal exchange rate. We estimate the model using annual data that spans over the period 1971-2010 and a method under which variables could be stationary or non-stationary, i.e., the bounds testing approach to cointegration and error-correction modeling. Our empirical results supports Friedman's volatility hypothesis in the short run as well as in the long run. Furthermore, including a measure of monetary uncertainty indeed results in a stable demand for money in Korea.

Appendix

Data Definition and Sources

All data are annual over the period 1971-2010 and collected from the International Financial Statistics of IMF.

Variables:

M2 = Money aggregate measured by real M2. Nominal M2 figures are deflated by GDP deflator.

Y: Real GDP.
r = interest rate defined as T-Bill rate.
NEX = defined as nominal effective exchange rate. A decline reflects a depreciation of Korean won.

V = Volatility measure of nominal M2. For each year it is defined as the standard deviation of 12 monthly nominal M2 values within that year. This approach is followed by others in other areas as well. For example, Bahmani-Oskooee and Hegerty (2009) who constructed the volatility measure of the real exchange rate, relied upon this definition.

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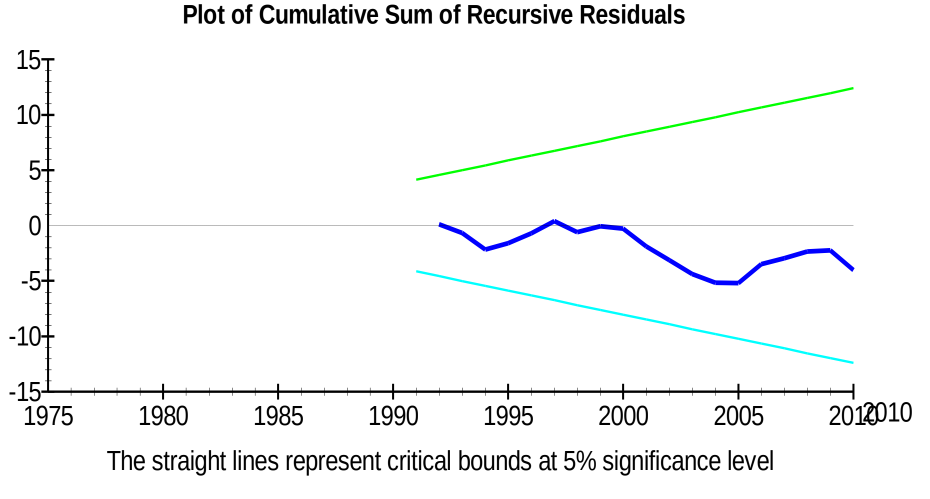
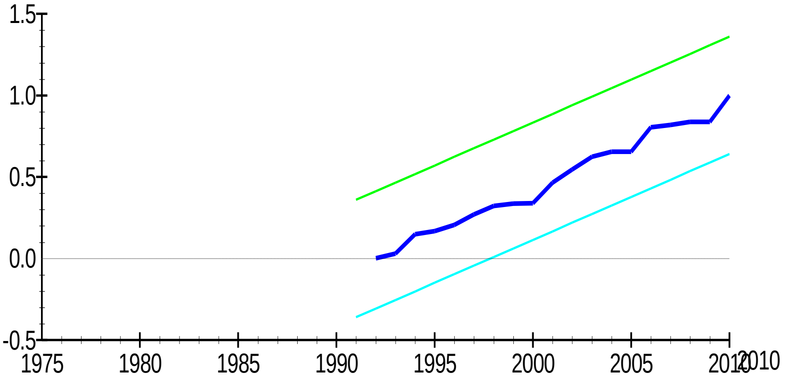
Figure-1. Plot of CUSUM and CUSUMSQ Tests



Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level