The Liquidity, Income, and Fisher Effects of Money on Interest: The Case of Developing Country

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This paper examines empirically the dynamic effect of money supply on interest rates. Since previous studies have a misspecification problem and overestimate the Fisher effect from the increase in money supply on interest, they do not find the dynamic response of money on interest rate. In order to provide the plausible dynamic relationship between money supply and interest rate and investigate how long the liquidity effect exists, this paper applies vector autoregressive (VAR) model and impulse response function.

Based on these econometric methods this paper reports new evidence on this issue. That is, the liquidity effect does not vanish fast, rather it appears to be significant during the first 5-7 quarters. The accumulative effect of money supply on interest rate is that the liquidity effect would be dominant over the income effect and the Fisher effect. (*JEL* Classification: E40, E43)

I. Introduction

A traditional monetary theory implies that changes in money growth are expected to affect nominal interest rates in different ways over time. The initial effect of money supply on interest is known as "the liquidity effect." Since the increase of money supply produces excess liquidity at the existing income, interest rates, and price level, interest rates can be reduced in short lags. However, this fall of interest stimu-

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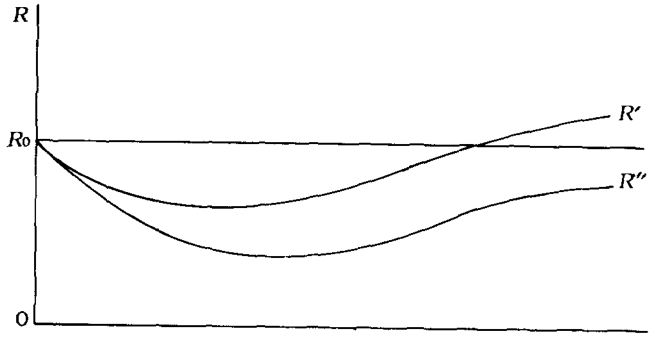


FIGURE 1

lates investment and private consumption and thereby income. The increase of money demand from the increase of income raises interest rates again. This mechanism is known as "income effect".

On the other hand, the increase in money growth can stimulate price level. As Fisher (1930) noted, nominal interest rates are affected by the increase in expected inflation. As the monetarist argues, the increase on price level due to money supply can lead proportionally to the rise of nominal interest rates if real interest rates are constant over time. However, the Keynesian approach stresses the liquidity effect rather than the Fisher effect. Therefore, the expected dynamic pattern of interest rates from money supply crucially depends on whether the liquidity effect dominates the income effect and the Fisher effect.

Based on simple least squares and two relevant variables in the model, money growth and interest rates, most previous researches have concentrated on the response of nominal interest rates to money supply (Cagan and Gandolfi 1969; Gibson 1970; Cagan 1972; Melvin 1983; Kim 1989; and Ham and Choi 1991). Therefore, they do not find plausible dynamic effect of response of interest rates to changes in money growth. In particular, Kim (1989) and Ham and Choi (1991) in the study of the developing country, Korea, report unreliable empirical evidence that the liquidity effect vanishes fast and thus the income effect and the Fisher effect dominate the liquidity effect.

However, this paper finds new evidence on this issue. The liquidity effect appears to be significant and does not vanish fast. Therefore, the expected dynamic pattern of interest rate would be $R_0 \rightarrow R''$ rather $R_0 \rightarrow R'$ than in Figure 1. This result implies that the liquidity effect of money supply on interest rates is not likely to be offset by the income effect and the Fisher effect from the increase in money supply. Thus, the monetary variable could have a negative correlation with interest rates in the short run as well as in the long run.

One serious flaw in Kim (1989) and Ham and Choi (1991) was their overestimation of the Fisher effect. They used overall expected inflation to compute the Fisher effect rather than expected inflation from the increase in money supply.

In order to distinguish the Fisher effect of the increase in money supply from the Fisher effect of overall expected inflation and to find the plausible dynamic lag pattern of interest rates in money supply, the vector autoregressive (VAR) model and impulse response function are applied.

Since impulse response function can allow enough lags in error shock analysis to investigate the dynamic response pattern of interest rates to changes in money growth, they are helpful in resolving the overestimation problem in computing the Fisher effect of money supply.

Based on these econometric methods this paper presents the new finding that an obvious liquidity effects exists during the first 5-7 quarters, after which the income effect and Fisher effect become dominant. Overall, the cumulative effect of money supply on interest rates appears to be the dominance of the liquidity effect over the income effect and Fisher effect.

This paper is organized as follows. In section II presents econometric methods. Section III presents new empirical results which will be compared with previous studies. Finally, section IV concludes the paper.

II. The Methodology

Following Sims (1980), this paper applies the vector autoregressive (VAR) technique and impulse response function to investigate the dynamic response of money supply on interest.

A linear multiple time series can be expressed as equation (1)

$$\begin{aligned} X_t &= A_1X_{t-1} + A_2X_{t-2} + \ldots\ldots + A_pX_{t-p} + U_t \\ &= \sum_{j=1}^{p} A_jX_{t-j} + U_t \\ &= A(L)X_t + U_t \end{aligned} \tag{1}$$

where $E(U_t) = 0$, $E(U_tU_t') = \Sigma$, $E(U_tU_s') = 0$ for $t \neq s$, and X_t is a suitably differenced (to achieve stationarity) row vector of K random variables.

Assuming that the determinants of $A(L)$ are outside the unit circle and that the expected value of the error vector is a null ($EU_t = 0$) then the moving average form can be derived as

$$X_t = B(L)\ U_t \tag{2}$$

$$(I - A(L))^{-1} = B(L) \tag{3}$$

where I = identity matrix

$B_{ij}(L)$ in equation (3) represents the dynamic response of X_i to shock of innovation in X_j. Therefore, it is referred to as an impulse response function. Unlike a simple least square which was the main econometric method in previous studies, we can analyze the dynamic lag pattern of liquidity effect, income effect and Fisher effect of money supply. One thing to note here is that explanatory variables in the VAR model should have explanatory power to derive impulse response function.

In order to derive impulse response function, expected inflation(= *EPI*), the ratio of real balance of money supply to real GNP ($LIQ = (M_2/P)$ /real GNP), and the ratio of real GNP to potential GNP(CU = real GNP/potential GNP), are used as X_t in VAR equation (1).[1] However, they do not represent the liquidity effect, the income effect and the Fisher effect of money supply on interest rates. The impulse response function of *LIQ* on nominal interest rate exactly represents the dynamic lag pattern of the liquidity, the income effect and the Fisher effect as time passes.

III. Data and Empirical Results

A. Data

This paper uses four explanatory variables in the VAR model, *LIQ* (= (M_2/P)/real GNP), *CU* (= real GNP/potential GNP), *EPI* (= expected inflation) and nominal interest rates.[2] *LIQ*, *CU* and *EPI* represent the liquid-

[1]Peek and Wilcox (1983) used (M_2/P)/potential GNP as the proxy of liquidity effect. However, this paper uses real GNP instead of potential GNP for two reasons. One is that the change of money supply can more directly affect the actual GNP rather than potential GNP. The other is that there could be a substantial gap between real GNP and potential GNP in Korea.

[2]The stationarity of explanatory variables may not be critical in the paper because variables used in the paper are assumed to be suitably differenced to achieve stationarity and the paper actually used the first-difference or the ratio of level variables.

TABLE 1
DATA DESCRIPTION

Variable	Description
LIQ	(M_2/P)/real GNP
*CU*14	real GNP/potential GNP14
CPI	Inflation of seasonally adjusted CPI.
RCB	Corporate bond returns (yearly, %)
EPI	Expected inflation
P	Consumer price index (1985=100)
Potential GNP14[3]	Potential GNP based on production function restricting on 2% of trade deficit to GNP.
M_2	Seasonally-adjusted money supply (M2)
T	Time Trend
SS	Import price index/GNP deflator

ity effect, the income effect and the Fisher effect, respectively. As in Table 1 GNP, money supply and price index are seasonally adjusted to avoid a seasonality problem. Potential GNP is obtained from estimate of production function after restricting on trade deficit (for example, restricting on 2% of trade deficit to GNP).

We use nominal corporate bond return as the proxy of long term nominal interest rates. The sample period is 1974. 1/1-1991. 2/4 and it produces 70 observations.

Data used in this paper has been obtained from various issues of the monthly bulletin of the Bank of Korea.

In order to measure the Fisher effect, expected inflation should be estimated. Most previous studies directly estimate expected inflation based on a rational expectation hypothesis or an adaptive expectation model or on survey data.[4] However, this paper computes expected inflation from the Fisher equation after estimating the ex ante real interest rate.[5] The reason for this is that the real interest rate is more

[3]The data of potential GNP are obtained from the Bank of Korea. Based on the Cobb-Douglas production function and generalized method of moments (GMM) Kim and Kim (1992) estimated the potential GNP in Korea. Besides labor and capital stock as inputs, research and development investment and time trend are also considered to reflect the technological progress in growth of GNP. See Kim and Kim (1992) in more detail for the estimation procedure of potential GNP.

[4]For example, in U.S. Livingston survey data is used frequently.

[5]See Appendix A in detail for the methodology of the estimation of the ex ante interest rate and the expected inflation.

TABLE 2

THE ESTIMATION OF EXANTE REAL INTEREST RATE ESTIMATION EQUATION

$r_t = T + T^2 + T^3 + \alpha_1 LIQ_{t-1} + \alpha_2 CU14_{t-1} + \alpha_3 CPI_{t-1} + U_t$

Label	Lag	Coefficient	Stand · Error	t-Statistic
T	0	2.74	0.34	8.11
T^2	0	-0.05	0.71E-02	-7.06
T^3	0	0.29E-03	0.48E-04	6.19
LIQ	1	-19.5	5.62	-3.47
CU14	1	-9.85	4.44	-2.22
CPI	1	-0.59	0.05	-12.55

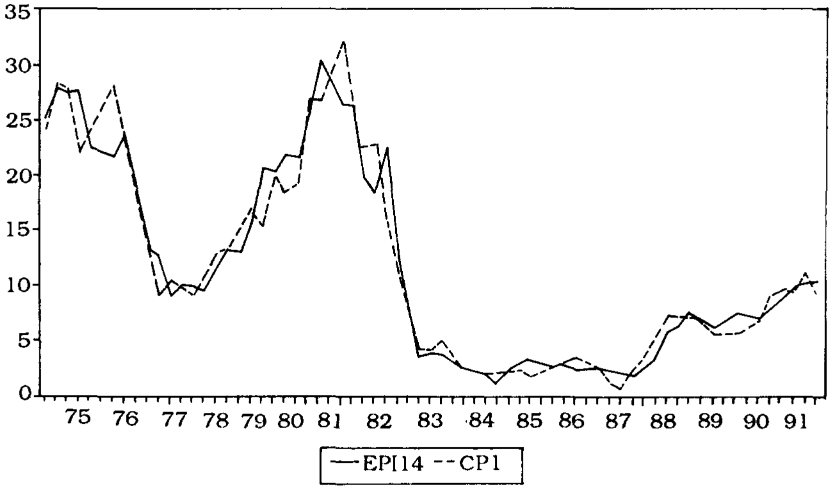


FIGURE 2

ESTIMATED EXPECTED INFLATION AND ACTUAL INFLATION

stable than actual inflation and thus the estimation of the real rate can be more reliable.

Table 2 presents the estimation results of real interest rate. Time trend, one lag of *LIQ*, *CU*, *CPI* are used as explanatory variables to affect real interest rate. Since other macro variables, for example, real government spending and import price do not provide additional explanatory power they are not considered.

Table 3 represents the results of the estimation of the Fisher equation. According to least square and AR(1) model the coefficients of the Fisher effect are 0.49~0.52. Therefore, we can infer that there could be a partial Fisher effect in Korea. However, a strong form of the Fisher

TABLE 3

RESULTS OF ESTIMATION OF THE FISHER EQUATION

$$R_t = 12.72 + 0.49EPI_t + U_t$$
$$(26.73) \quad (15.12)$$
$$R^2 = 0.77,\ D.W = 0.15$$

$$\text{AR(1)}: R_t = 13.23 + 0.52EPI_t + U_t$$
$$(16.72) \quad (11.48)$$
$$R^2 = 0.97,\ D.W = 1.47,\ \rho = 0.90\ (19.39)$$

Note: 1) t-value is in parenthesis
2) R_t = nominal interest rate, EPI = expected inflation

TABLE 4

(a) RESULTS OF VAR MODEL (Lag = 4)

Variable	Lag	Coefficient	Stand · Error	t-Statistic
LIQ	1	-15.43	7.11	-2.17
LIQ	2	6.96	8.70	0.80
LIQ	3	-1.07	8.94	-0.12
LIQ	4	15.71	7.30	2.15
*CU*14	1	-1.14	9.96	-0.12
*CU*14	2	13.36	12.22	1.09
*CU*14	3	7.51	12.31	0.61
*CU*14	4	18.41	9.11	2.02
*EPI*14	1	-0.16	0.16	-0.98
*EPI*14	2	-0.04	0.20	-0.22
*EPI*14	3	0.27	0.19	1.45
*EPI*14	4	-0.12	0.13	-0.92
RCB	1	0.95	0.26	3.62
RCB	2	-0.32	0.32	-1.00
RCB	3	-0.19	0.31	-0.61
RCB	4	0.50	0.20	2.49
Constant	0	-45.46	12.14	-3.74
T	0	0.57	7.11	1.34
T^2	0	-0.02	7.11	-1.49
T^3	0	-0.12E-03	0.87E-04	1.39

$R^2 = 0.96,\ D.W = 2.25$

(b) F-TESTS, DEPENDENT VARIABLE *RCB*

Variable	F-Statistic	Signif · Level
LIQ	2.58	0.050
*CU*14	5.85	0.001
*EPI*14	1.02	0.406
RCB	5.46	0.001

relationship can be rejected.

Table 4 reports empirical results of the VAR model. Lag = 4 is chosen as the optimal lag of the VAR system because the minimum value of the likelihood ratio is obtained at lag = 4. Potential GNP14 is used to compute *CU*14 and *EPI*14. Constant term and time trend are used to achieve stationarity. The results imply that income growth has a positive effect with four lag and the increase in expected inflation leads increase of nominal interest rate after three quarters. *LIQ* has a negative effect on interest rate after one quarter and it also has a positive effect after four quarters. These unequivocally imply that there are liquidity effect and income and Fisher effects from increase in money supply to interest rates. *F*-tests in Table 4 represent that *LIQ* and *CU*14 have significant explanatory power, however, *EPI* does not.

In order to investigate how long the liquidity effect exists and whether the liquidity effect dominates income effect and Fisher effect from money supply, the impulse response function of *LIQ* on interest is derived. The Fisher effect in the literature represents the dynamic effect of expected inflation from money supply on interest rates. Therefore, it should be distinguished from the Fisher effect of the increase in overall expected inflation. If we interpret *EPI* as the Fisher effect from money supply it may overestimate because money supply partly causes the increase in price level.[6] The impulse response function of *EPI* on interest produces dynamic response of the Fisher effect from the increase in overall expected inflation. Previous researches interpret the coefficients of *EPI* as the Fisher effect of money supply and thereby it results in an overestimation problem.

In order to avoid this problem and to find the plausible dynamic lag pattern of money supply on interest, the impulse response function of *LIQ* should be derived.

However, the plausible order of explanatory variables should be determined before analyzing impulse response function because the empirical results crucially depend on the ordering of explanatory variables. Block exogeneity test can help to resolve the ordering problem.

Table 5 represents the result of the exogeneity test. According to *F*-test in Table 5 the plausible ordering would be *LIQ*→*CU*14→*EPI*14→

[6]In Korea, literature on the studies of inflation implies that cost push inflation from oil shocks and wage increases also have significant effects on raising price levels. Since the increase in money supply is a part of inflation there could be an overestimation problem if we use overall expected inflation to investigate the dynamic effect of the increase in money supply on interest rates.

TABLE 5
BLOCK EXOGENEITY TEST: *F*-TEST

LIQ→*CU*14	*LIQ*→*CU*14	:	$\alpha = 0.022$
	*CU*14→*LIQ*	:	$\alpha = 0.072$
LIQ→*EPI*14	*LIQ*→*EPI*14	:	$\alpha = 0.018$
	*EPI*14→*LIQ*	:	$\alpha = 0.128$
*CU*14→*EPI*14	*CU*14→*EPI*14	:	$\alpha = 0.004$
	*EPI*14→*CU*14	:	$\alpha = 0.035$

Note: 1. α represents the significance level.
2. (→) represents the causal direction.

RCB. This direction is quite consistent with that of the standard macro economics theory.[7]

Based on this order impulse response function of *LIQ* in Table 6 implies that the increase in money supply significantly reduces interest until 7 quarters because of the liquidity effect and then, between 8 and 15 quarters, the interest rate rises because of the income effect and the Fisher effect. The accumulative dynamic effect of money supply to interest implies that the liquidity effect can dominate income effect and Fisher effect.[8] Therefore, the increase in money supply can lower real interest rate as well as nominal interest rate.[9]

Kim (1989) and Ham and Choi (1991) in Korea also analyzed this issue. They report that the liquidity effect vanishes fast and thus the Fisher effect is dominant over the liquidity effect. However, their results may be unreliable. In particular, Ham and Choi (1991) used similar explanatory variables in estimation of interest rates as in this paper. Since they relied on the simple reduced form the results cannot provide the dynamic response between money supply and interest rates. Further, since they interpreted the coefficient of *EPI* in simple reduced form as the Fisher effect of money supply the results have an overestimation problem.

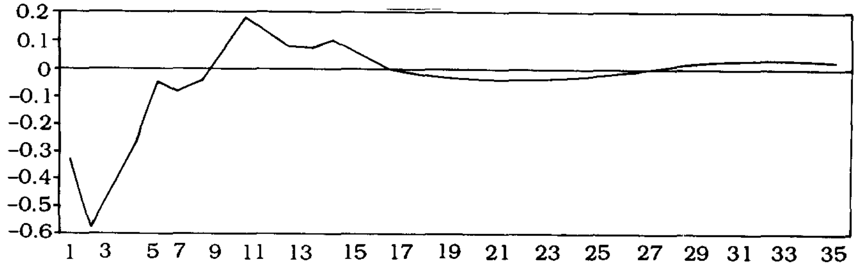
[7]This paper also examined the impulse response function for different ordering, for example, *LIQ*→*EPI*14→*CU*14→*RCB*. However, the result implies that there is no substantial difference between them.

[8]See Table B1 in Appendix B numerical values of dynamic effect of money supply on interest rates for details. The bottom of Table B1 in appendix also presents the accumulative impact of the liquidity effect, the income effect and the Fisher effect.

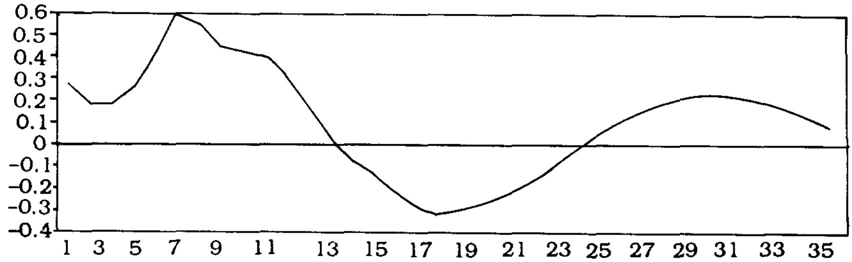
[9]Even if an alternative series of potential GNP instead of potential GNP14 used in this paper is used it basically produces the same results in Table 6. Therefore, empirical results are not presented here.

TABLE 5

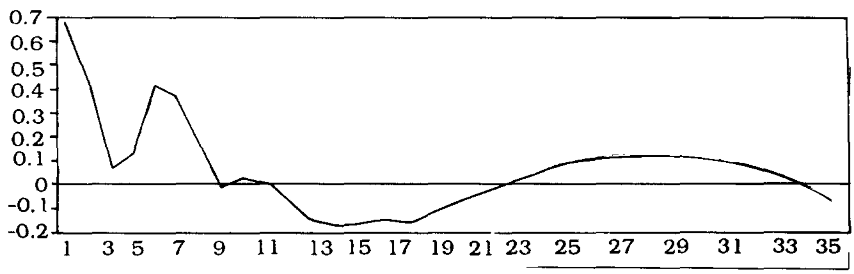
IMPULSE RESPONSE FUNCTION



(a) The Liquidity, Income, and Fisher Effect of Money Supply on Interest



(b) Overall Income Effect



(c) Overall Fisher Effect

On the other hand, Kim (1989) used the same method as that used by Cagan and Gandolfi (1969), and Melvin (1983). Twelve lags of percent change of money supply(Δm_t) regressed on the percent change of interest rate (Δi_t). This simple model can produce the dynamic relationship between money supply and interest rates. However, since he used only monetary variables to affect interest rates there is a chance that the empirical results are unreliable. Based on the same estimation equation and the same variables in Kim (1989) this paper also examines reliability of previous evidence. The empirical results of OLS in

TABLE 7

OLS RESULTS OF MONEY SUPPLY ON INTEREST ESTIMATION EQUATION:

$$\Delta i_t = \sum_{j=1}^{12} \beta_j \ \Delta m_{t-j} + U_t$$

Δi_t = percent change of interest

Δm_t = percent change of money supply (M2)

Variable	Lag	Coefficient	Stand · Error	*t*-Statistic
Δm_{t-1}	1	-22.91	10.46	-2.19
Δm_{t-2}	2	-21.80	10.42	-2.09
Δm_{t-3}	3	-5.08	10.02	-0.51
Δm_{t-4}	4	-9.33	9.41	-0.99
Δm_{t-5}	5	-0.98	9.13	-0.11
Δm_{t-6}	6	-3.97	9.11	-0.44
Δm_{t-7}	7	1.84	9.73	0.19
Δm_{t-8}	8	6.27	9.84	0.64
Δm_{t-9}	9	0.17	9.19	0.02
Δm_{t-10}	10	-1.41	9.13	-0.15
Δm_{t-11}	11	0.86	9.25	0.09
Δm_{t-12}	12	11.90	8.60	1.38

$R^2 = 0.18$, $D.W = 1.76$

Table 7 imply that the increase in money supply has a negative effect in the first two quarters, with positive effects appearing between 7 and 9 quarters. However, they are not significant. This result is basically consistent with that of the VAR model in this paper. Therefore, this paper argues that if previous researches correct the misspecification problem and overestimation of the Fisher effect, they can also produce results consistent with those of this paper.[10] The second and third panels of Table 6 represent the impulse response function of the overall income effect and the overall Fisher effect, respectively. They provide the same direction as standard macro economics theory.

IV. Summary and Conclusions

Based on the VAR model and impulse response function this paper investigates the dynamic response of money supply on interest rates in developing country, Korea. Since previous researches have a misspeci-

[10]Using a different unit of money supply and interest rate, this paper also analyzed the dynamic relation between money and interest. As presented in Table 2 and Table 3 of the Appendix, there is no evidence to support the positive relationship between two variables.

fication problem and overestimates the Fisher effect, empirical results could be unreliable. According to earlier studies, the liquidity effect vanishes fast and thereby the increase in money supply would raise the nominal interest rates in the long run. However, this paper finds new evidence on this topic. If the misspecification problem is corrected and a plausible econometric method is used to find the dynamic lag effect of money supply on interest rates, the liquidity effect does not vanish fast. Further, they appear to be significant.

Based on a vector autoregressive model and impulse response function, empirical results present new finding that the liquidity effect of money supply on interest exists in the first 5-7 quarters, from which time the income effect and Fisher effects become dominant. The accumulative impact of money supply on interest implies that the liquidity effect would be dominant over the income and Fisher effects. That is to say, the increase in money supply can have negative correlation with the nominal interest rate in the short run as well as in the long run.

This paper also reports that the overall income effect from income growth and the overall Fisher effect from expected inflation are obvious.

Appendix A

The Methodology for the estimation of the exante real interest rate and the expected inflation.

In order to estimate the exante real rate of interest and the expected inflation the Fisher equation and the expost real rates are defined as

$$R_t = rr_t + \pi_t^e \tag{A1}$$

$$r_t = R_t - \pi_t = rr_t - (\pi_t - \pi_t^e) = rr_t - e_t \tag{A2}$$

where R_t = the nominal interest rate at time t,

rr_t = the exante real interest rate at time t,

π_t^e = the expected inflation from $t-1$ to t,

r_t = the expost real interest rate at time t,

π_t = the actual inflation from $t-1$ to t,

e_t = the forecasting error term.

If we assume that market agents are rational in the sense that they use all available information at time $t-1$ to forecast expected inflation it produces the following conditions.

$$\pi_t^e = E(\pi_t/\phi_{t-1}) \tag{A3}$$
$$E(e_t/\phi_{t-1}) = 0$$
$$rr_t = E(r_t/\phi_{t-1}) \tag{A4}$$

where ϕ_{t-1} = all available information at time $t - 1$.

If the exante real rate, rr_t, is correlated with observable economic variables at time $t - 1$, X_{t-1}, then the optimal linear projection implies the conditions, (A5) and (A6).

$$P(rr_t/X_{t-1}) = X_{t-1}\beta \tag{A5}$$
$$rr_t = X_{t-1}\beta + U_t \tag{A6}$$

where $U_t = rr_t - P(rr_t/X_{t-1})$.

Substituting the condition (A6) into the condition (A2) the estimable equation can be derived.[11]

$$r_t = X_{t-1}\beta + U_t - e_t \tag{A7}$$

Using the estimated coefficients in equation (A7) the exante real rate and the expected inflation can be obtained.

$$\hat{rr}_t = X_{t-1}\hat{\beta}$$
$$\hat{\Pi}_t^e = R_t - \hat{rr}_t \tag{A8}$$

[11]See Mishkin (1984) for the econmetric issues of error terms, U_t and e_t, in details.

Appendix B

TABLE B1

	OUT 1	*OUT* 2	*OUT* 3
1	–0.33	0.28	0.68
2	–0.58	0.18	0.42
3	–0.41	0.18	0.06
4	–0.27	0.25	0.13
5	–0.04	0.40	0.42
6	–0.09	0.58	0.36
7	–0.05	0.53	0.36
8	0.06	0.43	–0.01
9	0.13	0.38	0.01
10	0.13	0.38	0.01
11	0.08	0.30	–0.07
12	0.08	0.15	–0.15
13	0.10	0.00	–0.17
14	0.06	–0.09	–0.16
15	0.02	–0.16	–0.15
16	–0.01	–0.24	–0.16
17	–0.01	–0.32	–0.15
18	–0.02	–0.34	–0.13
19	–0.04	–0.33	0.09
20	–0.05	–0.31	–0.05
21	–0.04	–0.27	–0.02
22	–0.04	–0.22	0.00
23	–0.04	–0.16	0.03
24	–0.03	–0.08	0.06
$\sum_{j=1}^{12} \varphi_j$	–1.256	4.060	2.016
$\sum_{j=1}^{24} \varphi_j$	–1.371	1.533	1.040

Note: 1. *OUT* 1: The impulse response function of 1% standard deviation shock of money supply on interest rates
2. *OUT* 2: The impulse response function of 1% standard deviation shock of income growth on interest rates
3. *OUT* 3: The impulse response function of 1% standard deviation shock of overall expected inflation on interest rates.

TABLE B2

OLS RESULTS OF MONEY SUPPLY ON INTEREST ESTIMATION EQUATION

$$i_t = \alpha_0 + \sum_{j=1}^{12} \beta_j \, m_{t-j} + U_t$$

where i_t = corporate bond return
m_t = growth rate of money supply (M2)

Varible	Lag	Coefficient	Stand · Error	*t*-Statistic
CONSTANT	0	20.18	2.38	8.50
DM2P	1	−43.27	36.06	−1.20
DM2P	2	−31.27	35.60	−0.87
DM2P	3	−8.79	35.70	−0.25
DM2P	4	−6.58	36.62	−0.17
DM2P	5	−4.12	35.90	−0.11
DM2P	6	−5.26	35.74	−0.15
DM2P	7	5.09	37.97	0.13
DM2P	8	9.79	42.19	0.23
DM2P	9	−5.40	38.99	−0.14
DM2P	10	−3.39	38.69	−0.9
DM2P	11	2.22	37.75	0.06
DM2P	12	21.08	32.49	0.65

$R^2 = 0.19$, $D.W = 0.10$

TABLE B3

OLS RESULTS OF MONEY SUPPLY ON INTEREST ESTIMATION EQUATION

$$i_t = \alpha_0 + \sum_{j=1}^{12} \beta_j ((M_2/P)/\text{real GNP})_{t-j} + U_t$$

where i_t = corporate bond return

Varible	Lag	Coefficient	Stand · Error	*t*-Statistic
CONSTANT	0	20.18	2.38	8.50
DM2P	1	−43.27	36.06	−1.20
DM2P	2	−31.27	35.60	−0.87
DM2P	3	−8.79	35.70	−0.25
DM2P	4	−6.58	36.62	−0.17
DM2P	5	−4.12	35.90	−0.11
DM2P	6	−5.26	35.74	−0.15
DM2P	7	5.09	37.97	0.13
DM2P	8	9.79	42.19	0.23
DM2P	9	−5.40	38.99	−0.14
DM2P	10	−3.39	38.69	−0.9
DM2P	11	2.22	37.75	0.06
DM2P	12	21.08	32.49	0.65

$R^2 = 0.41$, $D.W = 0.16$

References

Cagan, D.D., and Gandolfi, A. "The Lag in Monetary Policy as Implied by the Time Pattern of Monetary Effects on Interest Rates." *American Economic Review* (May 1969): 277-84.

Engle, R.F., and Granger, C.W. "Co-Integration and Error Correction: Representation, Estimation, and Testing." *Econometrica* 55 (March 1987): 251-76.

Fama, E.F., and Gibbson, M.R. "Inflation Real Returns and Capital Investment." *Journal of Monetary Economy* 9 (1982): 297-323.

Fisher, I. *Theory of Interest.* New York: MacMillan, 1930, Reprinted New York: Kelly 1961.

Gibson, W.E. "Price-Expectations Effects on Interest Rates." *Journal of Finance* 25 (March 1970): 19-34.

Judge, G.G. Hill, R.C., Griffiths, W.E., Lutkepohl, H., and Lee, T.C. *Introduction to the Theory and Practice of Econometrics.* John Wiley and Sons, 1988.

Ham, Jung ho, and Choi, Wongyu. "The Analysis of the Determination of Interest Rate: The Case of Korea." *Monthly Bulletin of the Bank of Korea* (March 1991): 3-49.

Keynes, J.M. *A Treatise on Money.* London, MacMillan, 1930,Reprinted London: the Royal Economic Society, 1971.

Kim, Byung Wha, and Kim, Yuncheol "Estimates of Potential GNP: The Case of Korea." *Monthly Bulletin of the Bank of Korea* (February 1992): 20-50.

Kim Sung Min "Monetary Aggregate and Market Rate of Interest as the Intermediate Target of Monetary Policy." *Monthly Bulletin of the Bank of Korea* (February 1989): 17-30.

Levi, M.D., and Makin, H. "Anticipated Inflation and Interest Rates: Further Interpretation of Findings on the Fisher Equation." *American Economic Review* 68 (December 1978): 801-12.

Makin, J.H. "Real Interest, Money Surprises, Anticipated Inflation and Fiscal Deficits." *Review of Economics and Statistics* 65 (August 1983): 374-84.

Melvin, M. "The Vanishing Liquidity Effect of Money on Interest: Analysis and Implications for Policy." *Economic Inquiry* 21 (April 1983): 188-202.

Mishkin, F.S. "The Real Interest Rate: An Empirical Investigation." *Carnegie-Rochester Series on Public Policy* 16 (1981).

______________. "The Real Interest Rate: A Multicountry Empirical Study." *Canadian Journal of Economics* (June 1984): 283-311.

Mundell, R. "Inflation and Real Interest." *Journal of Political Economy* 71 (June 1963): 280-3.

Nam, Joo-Ha. "The Fluctuation of Real Interest Rate and the Choice of Intermediate Target of Monetary Policy." Working Paper No. 62-91-17, Korea Economic Research Institute, 1991.

Peek, J. "Interest Rates, Income Taxes, and Anticipated Inflation." *American Economic Review* 72 (December 1982): 980-91.

Peek, J., and Wilcox, J.A. "The Postwar Stability of Fisher Effect." *Journal of*

Finance 38 (September 1983): 1111-24.

Sargent, T.J. "Anticipated Inflation and Nominal rate of Interest." *Quarterly Journal of Economy* 16 (May 1972): 212-25.

Sims, C.A. "Macroeconomic and Reality." *Econometrica* 48 (January 1980): 1-48.

Tobin, J. "Money and Economic Growth." *Econometrica* 33 (October 1965): 671-84.

Visco, I. "Anticipated Inflation and the Nominal Rate of Interest? Further Result." *Quarterly Journal of Economics* 89 (May 1975): 303-10.