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PRICE EXPECTATIONS AND TESTS ON THE RATIONAL EXPECTATIONS HYPOTHESIS IN MONEY MARKET AND PHILLIPS CURVE

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ABSTRACT

The importance of expectations has been realistically recognized since Muth's opening paper on rational expectations. Further Lucas's critique, Prescott's local market with incomplete information and Sargent's stochastic macroanalysis have contributed to extending or complementing traditional marcoeconomic theory and applications.

As the rational expectations theory has gained sounded ground on macroeconomics, it is real interest how to test the rational expectations hypothesis. So far lots of researches on the fields have been made. However, most of results from past works were not only based statistical data on developed countries but were also derived by either monetary sector or real sector. They could not show testing the rational expectations hypothesis in incorporating monetary sector with real sector.

In this work, investigating the theoretical issues on testing the rational expectations hypothesis, we test the hypothesis in a simultaneous model consisting of the function to form price expectations, money demand function and Phillips curve jointed with price expectations in Korea.

According to the testing results, the rational expectations hypothesis accepted at 5 percent significant level. This suggests money demands have been highly sensitive to price expectations and there has not been trade-off between inflation rate and non farm unemployment rate.

Therefore, we have the followng monetary policy implications in Korea : (i) economic agents' expectations on price have been toward rational stages; (ii) since the rational expctations hypothesis cannot be rejected on the basis of M_1, the discretionary policy in M_1 would disturb in forming expctations of price; (iii) according to the validity of the rational expectations hypothesis, setting the monetary policy rule of M_1 is desirable for stabilizing Korea's economy rather than that of M_2; (iv) so long as the monetary policy rule of M_1 is effectively introduced and is known to economic agents, some flexibility in managing M_2 with a narrow margin between upper and lower limits would partial effects on real economy (e. g., employment, output, investment) under stable backgrounds on money market.

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This work consists of four parts : in the first past it's pointed out why price expectations are theoretically important in money market and Phillips curve. Two kinds of methods testing the rational expectations hypothesis are theoretically examined in the seconde part. With quarterly data 1971 – 1986 the validity of the rational expectations hypotesis in Korea's money market and Phillips curve is tested in the third part. Finally, We remark some policy implications on monetary policy, price expectations and Phillips curve in Korea.

I. THE IMPORTANCE OF PRICE EXPECTATIONS

Price expectations in money market are crucial in both theoretical and empirical senses. First, in theoretical aspects including price expectations into the demand for money and Phillips curve extends the traditional money demand function and the standard Phillips curve to depending on more comprehensive variables, since price expectations are conditionally formed on the basis of comprehensive information set. Second, price expectations have the demand for money interrelated to the supply of money, since an increase of monetary supply raises the price level, resulting in higher expected price, and hence reducing the demand for money. This approach is different from the past one that the demand for money has been analyzed independently of the supply of money. On the other hand, inclusion of price expectations into Phillips curve gives completely different insights on it by showing how monetary policy affects unemployment or output through price expectations. Third, in econometric issues it has been argumentable how to test the rational expectations hypothesis (Barro, Lucas, Sargent). The one key issue is how to test for the validity of the rational expectations hypothesis within economic model. The central idea introduced is that of "restrictions" : When combined with an economc theory in which expectations are important the rational expectations hypothesis generally implies precise restrictions on what we should observe in the real world, and so its validity can be tested by testing for the validity of these restrictions.

The other key issue is to evaluate different possible macroeconomic policies : the coefficients estimated by the rational expectations model are unlikely to remain unchanged under different policy regimes, whereas the estimated model in the traditional econometric method will remain unchanged in the face of different policies and therefore be used to evaluate different policies. Hence, in estimating the coefficient of the expected varible the comprehesive variables in the information set used for regressing the expected variable should be entered separately in the model rather than as a single variable.

II. TESTS ON THE RATIONAL EXPECTATIONS HYPOTHESIS

Consider the following model with price expectations.

(1) $\dot{p}_t = a_1(u^* - u_t) + a_2\dot{p}_t^e + e_t$

(2) $log(M/P)_t = b_1 log\ i_t + b_2 log\ Y_t + b_3 log\ p_t^e$

$$+ b_4 log(M/P)_{t-1} + b_5\dot{p}_t + b_6 D_t + g_t$$

where M = nomial money supply (M_1)

P = consumer price level

u = non farm unemployment rate

i = the interest rate due to one year saving accounts

Y = the real GNP

D = dummy variable

p_t^e = expected price at t conditioned on the information available at $t-1$

e_t, g_t = random errors with mean zero

Equation (1) is Phillips curve and equation (2) is money demand function. Since the expected price variable is included in both functions, how price expectations are formed rationally is crucial in estimating both the money demand function and Phillips curve.

Let's investigate two methods to estimate the model.

1. Know Some Variances

The rationality of expectations implies that

(3) $log\ p_t = log\ p_t^e + v_t$

or $log\ p_t^e = log\ p_t - v_t$. $E_{t-1} v_t = 0$ for $i \geq 0$

Substitute the equation (3) into the equation (2), for example.
Then, equation (2) can be rewritten as

(4) $$log\ (M/p)_t^d = b_1 log\ i_t + b_2 log\ Y_t + b_3 log\ p_t + b_4 log\ (M/p)_{t-1}^d + b_5 \dot{p}_t + b_6 D_t + g_t - b_4 v_t$$

To estimate coefficients, it might be thought that one could carry out the following regression,

(5) $$log\ (M/p)_t^d = b_1 log\ i_t + b_2 log\ Y_t + b_3^* log\ p_t + b_4 log\ (M/p)_{t-1}^d + b_5 \dot{p}_t + b_6 D_t + g_t^*$$

where g_t^* is an error term, and treat the value obtained for b_3^* as an estimator of b_3. This might be an attractive feature of the rational expectations hypothesis.

Unfortunately, this method is not valid, for if expectations are rational, then equation (3) implies that p_t is positively correlated with v_t. Hence the estimator of b_3^* will be biased away from b_3.

More formaly, if equation (3) to (5) are the truth and we carry out an ordinary least squares regression of $(m/p)_t^d$ on p_t as shown in equation (5), then, assuming we have a very large sample, our estimate of b_3^* will be obtained as

(6) $$b_3^* = \frac{cov(log(M/p)_t^d,\ log\ p_t)}{var(log\ p_t)}$$

Assuming i_t, Y_t, $(M/p)^d_{t-1}$, g_t are uncorrelated with p_t, and put $\dot{p}_t$ estimated by (1) into (2), we can drive

$$cov(log(M/p)^d_t,\ log\ p_t) = b_3 var(log\ p_t) - b_3 var(log\ p_t,\ v_t) = b_3 var(log\ p_t) - b_3 var(v_t)$$

Thus our estimator of b_3^* is

$$(7)\quad b_3^* = \frac{b_3 var(log\ p_t) - b_3 var(v_t)}{var(log\ p_t)}$$

$$= b_3 - \frac{b_3 var(v_t)}{var(log\ p_t)}$$

So our estimator, b_3^* will equal b_3 only if variance of v_t are zero for all t, which means expected price is perfectly acurate. If our measure of expected income is perfectly inaccurate in the sense that all changes in p_t reflect variations in v_t, then our estimate of b_3^* will tend to zero.

Therefore, so long as variance of v_t is positive, to be able to obtain a separate estimate of b_3^* we need more information about variance of v_t and variance of $log\ p_t$.

This implies that the above method of estimating the coefficient of a expected variable is valid, if information about some variances are known. Otherwise, b_3^* is downwardly biased to b_3.

Similarly, in estimating equation (1) the above method of estimating the coefficient of a expected variable needs some information of variances of e_t and p_t.

2. Instrumental Variable Method for Expected Price.

A more important and fruitful method of incorporating rational expectations into a macroeconomic model makes use of the central idea of rational expectations that variables are determined by processes. This means that expectations of price are conditionally formed on the comprehensive information.

Suppose the process determining p_t in the model above is

$$(8)\quad log\ p_t = c_1 log\ IMP_{t-1} + c_2 log\ o_{t-1} + c_3 log\ p_{t-1} + c_4 log\ M_{t-1} + z_t$$

where IMP = import price index

O = the price of Bunker c

z_t = random error with mean zero.

If expectations are rational we can write

$$(9)\quad log\ p_t^e = c_1 log\ IMP_{t-1} + c_2 log\ o_{t-1} + c_3 log\ p_{t-1} + c_4 log\ M_{t-1}$$

where $p_t^e = E\ [\ p_t\ |\ IMP_{t-i},\ O_{t-i},\ p_{t-i},\ M_{t-i}$ for $i \geq 1$].

Substitute the estimated $log\ p_t^e$ (9) into (1), where

$$\dot{p}_t^e = c_1 \dot{IMP}_{t-1} + c_2 \dot{o}_{t-1} + c_3 \dot{p}_{t-1} + c_4 \dot{M}_{t-1},$$

(10) $\dot{p}_t = a_1(u^* - u_t) + a_2\hat{c}_1 I\dot{M}P_{t-1} + a_2\hat{c}_2\dot{o}_{t-1} + a_2\hat{c}_3\dot{p}_{t-1} + a_2\hat{c}_4\dot{M}_{t-1} + e_t$

where "^" over a variable or coefficient denotes our estimate of the variable, and '·' over a variable represents the differential with respect to time.

It is clear from equation (9) and (10) that we could employ a two-stage procedure to obtain estimators of c_1, c_2, c_3, c_4 and a_1, a_2.

Then, the estimated $\dot{p}_t$ is put into equation (2) with the estimator of $log\ p_t^e$ in (9).

(11) $log\ (M/p)_t = b_1 log\ i_t + b_2 log\ Y_t + b_3\hat{c}_1 log\ IMP_{t-1} + b_3\hat{c}_2 log\ o_{t-1} + b_3\hat{c}_3 log\ p_{t-1}$

$+ b_3\hat{c}_4 log\ M_{t-1} + b_4 log\ (M/p)_{t-1} + b_5\hat{\dot{p}}_t + b_6 D_t + g_t$

$= b_1 log\ i_t + b_2 log\ Y_t + b_3\hat{c}_1 log\ IMP_{t-1} + b_3\hat{c}_2 log\ o_{t-1}$

$+ (b_3\hat{c}_3 - b_4) log\ p_{t-1} + (b_3\hat{c}_4 + b_4) log\ M_{t-1} + b_5\hat{\dot{p}}_t + b_6 D_t + g_t$

So we employed three-stage procedure in estimating equation (1), (2) and (9).

The key element in treating price expectations is that the four variables which together add up to p_t^e in equation (9) have to be contained separately to form the single expected variable as in equation (10) and (11). This procedure implies that each variable in information set is important in forming price expectation. Then the resulting estimates of the coefficient of the expected price would be consistent. The problem experienced when using actual price to measure expected price as in the previous method would disappear under this procedure, since our measure of expected price is no longer correlated with the error term of z_t.

Hence, the rational expectations hypothesis suggests a valid method of incorporating additional information when estimating macroeconomic models which contain expectations terms. The important factor in estimating such a macroeconomic model is that the process determing the variable about which expectations are being formed has to be estimated alongside the rest of the model.

3. Tests of the Rational Expectations Hypothesis.

On the basis of instrumental variable method let's discuss a way of testing the validity of the rational expectations hypothesis itself with the previous model.

With a three stage procedure, we can write $\dot{p}_t$ and $log(m/p)_t^d$ in accordance with equation (10) and (11) by imposing rationality restrictions.

(10) $\dot{p}_t = a_1(u^* - u_t) + a_2^1\hat{c}_1 I\dot{M}P_{t-1} + a_2^2\hat{c}_2\dot{o}_{t-1} + a_2^3\hat{c}_3\dot{p}_{t-1} + a_2^4\hat{c}_4\dot{M}_{t-1} + e_t$

(11) $log\ (M/p)_t^d = b_1 log\ i_t + b_2 log\ Y_t + b_3^1\hat{c}_1 log\ IMP_{t-1} + b_3^2\hat{c}_2 log\ o_{t-1}$

$+ (b_3^3\hat{c}_3 - b_4^1) log\ p_{t-1} + (b_4^2 + b_3^4\hat{c}_4) log\ M_{t-1} + b_5\hat{\dot{p}}_t + b_6 D_t + g_t$

Here, the rationality of expectations imposes restrictions on what we should find when estimate equation (10) and (11), where a_i are estimated coefficients in the first stage in equation (8). So if expectations are rational, the following seven restrictions should be imposed.

$$a_2^1 = a_2^2 = a_2^3 = a_2^4,$$
$$b_3^1 = b_3^2 = b_3^3 = b_3^4, \text{ and}$$
$$b_4^1 = b_4^2$$

In testing the validity of the above restrictions, the essential idea behind them is clear. When a restriction is imposed on a model of a particular variable's behavior, if that restriction is valid its imposition should not affect the model's success in explaining the variable's behavior, whereas if the restriction is invalid it should. In this context, test of the rational expectations hypothesis is to test the rationality restrictons imposed on the coefficients.

Hence, consider the above model with rationality restrictions and without them, separately.

(The model with rationality restrictions)

$$log\ p_t = c_1 log\ IMP_{t-1} + c_2 log\ o_{t-1} + c_3 log\ p_{t-1} + c_4 log\ M_{t-1} + z_t$$

$$\dot{p}_t = a_1(u^* - u_t) + a_2^1\hat{c}_1 I\dot{M}P_{t-1} + a_2^2\hat{c}_2\dot{o}_{t-1} + a_2^3\hat{c}_3\dot{p}_{t-1} + a_2^4\hat{c}_4\dot{M}_{t-1} + e_t$$

$$log\ (M/p)_t^d = b_1 log\ i_t + b_2 log\ Y_t + b_3^1\hat{c}_1 log\ IMP_{t-1} + b_3^2\hat{c}_2 log\ o_{t-1}$$

$$+ (b_3^3\hat{c}_3 - b_4^1) log\ p_{t-1} + (b_4^2 + b_3^4\hat{c}_4) log\ M_{t-1} + b_5\hat{p}_t + b_6 D_t + g_t$$

(The model without rationality resrictions)

$$log\ p_t = c_1 log\ IMP_{t-1} + c_2 log\ o_{t-1} + c_3 log\ p_{t-1} + c_4 log\ M_{t-1} + z_t$$

$$\dot{p}_t = c_5(c^* - u_t) + c_6 I\dot{M}P_{t-1} + c_7\dot{o}_{t-1} + c_8\dot{p}_{t-1} + c_9\dot{M}_{t-1} + h_t$$

$$log\ (M/p)_t^d = c_{11} log\ i_t + c_{12} log\ Y_t + c_{13} log\ IMP_{t-1} + c_{14} log\ o_{t-1}$$

$$+ c_{15} log\ p_{t-1} + c_{16} log\ M_{t-1}^d + c_{17}\dot{p}_t + c_{18} D_t + w_t$$

Assume z_t, g_t, h_t and w_t are normally distributed. When rationality restrictions are linear, the F-test could be used. However, we will take the likelihood ratio test which can be used in more general situations with linear or non-linear ones. Since our model contains non-linear restrictions, the likekihood ratio test is valid.

Remember the likelihood ratio test static for large samples is defined as $n\,[log\ det(\hat{\Sigma}) - log\ det(\hat{\Omega})]$, which is distributed as a chi-square variate with g (the number of restrictions on the model) degrees of freedom, where $det(\hat{\Sigma})$ and $det(\hat{\Omega})$ are the determinant of the variance—covariance matrix of the model with rationality restrictions and without them, respectively.

The variance—covariance matrix of the model with rationality restrictions is

$$(12)\quad E\begin{bmatrix} z_t \\ e_t \\ g_t \end{bmatrix}[z_t,\ e_t,\ g_t] = \begin{bmatrix} E(z_t^2) & E(z_t e_t) & E(z_t g_t) \\ E(e_t z_t) & E(e_t^2) & E(e_t g_t) \\ E(g_t z_t) & E(g_t e_t) & E(g_t^2) \end{bmatrix} = \begin{bmatrix} \sigma_z^2 & \sigma_{ze} & \sigma_{zg} \\ \sigma_{ez} & \sigma_e^2 & \sigma_{eg} \\ \sigma_{gz} & \sigma_{ge} & \sigma_g^2 \end{bmatrix} = \hat{\Sigma}$$

The variance—covariance matrix of the model without rationality restrictions is

(13) $$E\begin{bmatrix} z_t \\ h_t \\ w_t \end{bmatrix} [z_t , h_t , w_t] = \begin{bmatrix} E(z_t^2) & E(z_t h_t) & E(z_t w_t) \\ E(h_t z_t) & E(h_t^2) & E(h_t w_t) \\ E(w_t z_t) & E(w_t h_t) & E(w_t^2) \end{bmatrix}$$

$$= \begin{bmatrix} \sigma_z^2 & \sigma_{zh} & \sigma_{zw} \\ \sigma_{hz} & \sigma_h^2 & \sigma_{hw} \\ \sigma_{wz} & \sigma_{wh} & \sigma_w^2 \end{bmatrix} = \hat{\Omega}$$

If the restrictions are valid we would expect the generalized variance from the rstricted and unrestricted models to be approximately the same. Hence, the above testing procedure of the rational expectations hypothesis is reduced to the test of cross—equation restrictions.

Ⅲ. SOME EMPIRICAL RESULTS ON TESTS OF THE RATIONAL EXPECTATIONS HYPOTHESIS

The previous model was constructed for testing the rational expectations hypothesis in Korea's money market and Phillips curve with the quarterly data from 1971 to 1986.

With M_1(cash + demand deposits) the regressional results on the expected price, the money demand function and Phillips curve under rationality restrictions are shown in equation (14) through (16).

(14) $$\log p_t^* = 0.07123483 \log IMP_{t-1} + 0.02500060 \log o_{t-1} + 0.8597943 \log p_{t-1} + 0.02916216 \log M_{t-1}$$

(15) $$\dot{p}_t = 0.0003816071\ (6.3860 - u_t) + 0.9516326\ \dot{p}_t^* + e_t$$
$$= 0.002436911 - 0.0003816071\ u_t + 0.06778938 \log I\dot{M}P_{t-1} + 0.023791386\ \dot{o}_{t-1} + 0.818208285\ \dot{p}_{t-1} + 0.027751662\ \dot{M}_{t-1} + e_t$$

(16) $$\log (M/p)_t^d = -0.06780426 \log i_t + 0.1970722 \log Y_t - 0.06235623 \log p_t^* + 0.6493406 \log (M/p)_{t-1} - 1.696752\ \hat{\dot{p}}_t - 0.01658978\ D_t + g_t$$
$$= -0.06780426 \log i_t + 0.1970722 \log Y_t - 0.00444193544 \log IMP_{t-1} - 0.0015589 \log o_{t-1} - 0.702954 \log p_{t-1} + 0.647522 \log M_{t-1} - 1.696752\ \hat{\dot{p}}_t - 0.01658978\ D_t + g_t$$

The test statistic of equation (14) to (16) is shown in Appendix 1.

According to the testing result of equation (16), in Korea 1% increase in expected price has reduced about 0.0623% decrease in real money demand, which has the negative effect on real demand for money.

On the other hand, with M_1 the regressional results on the money demand function and Phillips curve without rationality restrictions are shown in equation (17) and (18)

(17) $$\dot{p}_t = 0.002027582 - 0.0004564104\, u_t + 0.1015187\, \dot{IMP}_{t-1} + 0.021122\, o_{t-1} + 0.799531\, \dot{p}_{t-1} + 0.061982\, \dot{M}_{t-1} + h_t$$

(18) $$\log (M/p)^d_t = -0.05503796 \log i_t + 0.1977771 \log Y_t -0.1130776 \log IMP_{t-1} - 0.0067465 \log o_{t-1} -0.468166 \log p_{t-1} + 0.017412 \log M_{t-1} -1.217629\, p_t - 0.0222153\, D_t + w_t$$

The test statistic of equation (17) and (18) is shown in Appendix 2.

Then, from equation (14) to (16) the variance—covariance matrix ($\hat{\Sigma}$) under rationality restrictions is

$$\hat{\Sigma} = \begin{bmatrix} .13036E-03 & .43301E-05 & -.85617E-06 \\ & .14373E-04 & -.94248E-05 \\ & & .13021E-03 \end{bmatrix}$$

Determinant = .23001E − 12

And from equation (14), (17) and (18), the variance—covariance matrix ($\hat{\Omega}$) without restrictions is

$$\hat{\Omega} = \begin{bmatrix} .13036E-03 & .50174E-05 & -.31963E-05 \\ & .13036E-04 & -.95843E-05 \\ & & .11358E-03 \end{bmatrix}$$

Determinant = .17836E − 12

Hence, the likelihood ratio test statistic is distributed as a chi—square variate with 7 degrees of freedom.

$$X^2_7 = n\,[\,\log (\det \hat{\Sigma}) - \log (\det \hat{\Omega})\,] = 13.989$$

The resulting test statistic is 13.989 which has to be compared with 14.07 which is the critical value under the chi—square distribution at the 5 percent significant level with 7 degrees of freedom. So the null hypothesis, that we imposed the rational expectations hypothesis on the expected price, cannot be rejected. In this context the rational expectations hypothesis cannot be rejected.

This result implies that so long as economic behaviors have open informations on i_t, y_t, IMP_{t-1}, o_{t-1}, P_{t-1} and M_{t-1}, expected price can be rationally formed, and thereby expectations on price had considerablely negative effects on real demad for money and significant effects on Phillips curve in Korea.

Ⅳ. RATIONAL EXPECTATIONS AND MONETARY POLICY IMPLICATIONS IN KOREA

We have considered the simple model consisting of price expectations, money demand (M_1) and Phillips curve. This model is meaningful in incorporating monetary sector with real sector for testing the rational expectations hypothesis. We test rationality restrictions by using the maximum likelihood ratio. In equation (15) we find the coefficient of price expectations approaching to almost 1. Price expectations (p_t^e) have relatively weaker effects on money demand than other variables in equation of (16) on the basis of price expectations formed from (14).

According to the testing results, the rational expectations hypothesis is accepted at 5 percent significant level. This suggests money demands have been reduced from future price expectations and there has not been trade—off between inflation rate and non farm unemployment rate.

Therefore, we have the following monetary policy implications in Korea : (i) economic agents' expectations on price have been toward rational stages; (ii) since the rational expectations hypothesis cannot be rejected on the basis of M_1, the discretionary policy in M_1 would disturb in forming expectations of price; (iii) according to the validity of the rational expectations hypothesis, setting the monetary policy rule of M_1 is desirable for stabilizing Korea's economy rather than that of M_2; (iv) so long as the monetary policy rule of M_1 is effectively introduced and is known to economic agents, some flexibility in managing M_2 with a narrow margin between upper and lower limits would partial effects on real economy (e. g., employment, output, investment) under stable backgrounds on money market (Kim).

Appendix 1

(i) Testing Result on $log\ p_t^e$

```
DEPENDENT VARIABLE   11      LNCPI
FROM    71:  4  UNTIL    87:  1
OBSERVATIONS              62     DEGREES OF FREEDOM     58
R**2              .99960422      RBAR**2          .99958375
SSR          .85772090E-02       SEE          .12160712E-01
DURBIN-WATSON    .18238850
Q(  21)=    242.457       SIGNIFICANCE LEVEL  .000000
```

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC	SIGNIF LEVEL
***	*******	***	***	************	************	************	************
1	LNIMPPI	9	1	.7123483E-01	.7079606E-02	10.06198	.2471197E-13
2	LNOIL	10	1	.2500060E-01	.4191843E-02	5.964106	.1561848E-06
3	LNCPI	11	1	.8597943	.2072775E-01	41.48035	.0000000
4	LNM1A	12	1	.2916216E-01	.1023590E-01	2.849008	.6059975E-02

(ii) Testing Result on $\dot{p}_t$ under Rationality Restrictions

DEPENDENT VARIABLE 30 PDOTD
FROM 73: 1 UNTIL 87: 1
OBSERVATIONS 57 DEGREES OF FREEDOM 54
R**2 .90270568 RBAR**2 .89910219
SSR .79739551E-03 SEE .38427312E-02
DURBIN-WATSON 1.52861606
Q(21)= 28.8280 SIGNIFICANCE LEVEL .118192

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC	SIGNIF LEVEL
***	*******	***	***	***********	***********	***********	***********
1	CONSTANT	0	0	.2436911E-02	.1367713E-02	1.781742	.8041481E-01
2	URATED	31	0	-.3816071E-03	.3814898E-03	-1.000307	.3216232
3	IMPPIHD	32	1	.9516326	.4347441E-01	21.88949	.5023412E-16
4	OILHD	33	1	.9516326	.4347441E-01	21.88949	.0000000
5	CPIHD	34	1	.9516326	.4347441E-01	21.88949	.0000000
6	M1AHD	35	1	.9516326	.4347441E-01	21.88949	.0000000

RHO = 0.437200

(iii) Testing Result on *log (M/p)*$_t$ under Rationality Restrictions

DEPENDENT VARIABLE 46 LNM1PHD
FROM 73: 3 UNTIL 87: 1
OBSERVATIONS 55 DEGREES OF FREEDOM 49
R**2 .94193994 RBAR**2 .93601544
SSR .70312382E-02 SEE .11978926E-01
DURBIN-WATSON 1.09300428
Q(21)= 34.1753 SIGNIFICANCE LEVEL .347034E-01

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC	SIGNIF LEVEL
***	*******	***	***	***********	***********	***********	***********
1	LNRDBD	56	0	-.6780426E-01	.1681358E-01	-4.032707	.1923620E-03
2	LNGNPD	57	0	.1970722	.5141159E-01	3.833226	.3611226E-03
3	LNIMPHD	47	1	-.6235623E-01	.4729944E-01	-1.318329	.1935229
4	LNOILHD	48	1	-.6235623E-01	.4729944E-01	-1.318329	.1935229
5	LNCPID	50	1	-.7029542	.8502432E-01	-8.267684	.3793656E-08
6	LNM1AD	51	1	.6475222	.8903109E-01	7.272990	.6227033E-08
7	INSPDOTD	49	0	-1.696752	.3686762	-4.602283	.2980775E-04
8	DUMMY	15	0	-.1658978E-01	.6170972E-02	-2.688357	.9783807E-02

$(RHO)_1 = 0.630424$ $(RHO)_2 = 0.258519$

APPENDIX 2

(i) Testing Result on $\dot{p}_t$ without Restrictions

```
DEPENDENT VARIABLE  30     PDOTD
FROM    73: 1 UNTIL    87:  1
OBSERVATIONS            57     DEGREES OF FREEDOM     51
R**2            .91671592      RBAR**2           .90855082
SSR          .76237211E-03     SEE          .38663255E-02
DURBIN-WATSON  1.51901339
Q(  21)=    26.2188         SIGNIFICANCE LEVEL  .198227
```

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC	SIGNIF LEVEL
***	*******	***	***	***********	***********	***********	***********
1	CONSTANT	0	0	.2027582E-02	.1760687E-02	1.151586	.2548614
2	URATED	31	0	-.4564104E-03	.3948941E-03	-1.155779	.2531575
3	IMPPIHD	32	1	1.425127	.4899064	2.908978	.5359854E-02
4	OILHD	33	1	.8448726	.7474048	1.130408	.2635924
5	CPIHD	34	1	.9299102	.7207949E-01	12.90118	.3718988E-08
6	M1AHD	35	1	2.125446	1.088365	1.952881	.5633184E-01

RHO = 0.398693

(ii) Testing Result on *log* $(M/p)_t$ without Restrictions

```
DEPENDENT VARIABLE  46     LNM1PHD
FROM    73: 3 UNTIL    87:  1
OBSERVATIONS            55     DEGREES OF FREEDOM     47
R**2            .97216193      RBAR**2           .96801583
SSR          .61331928E-02     SEE          .11423374E-01
DURBIN-WATSON   .95334274
Q(  21)=    31.3319         SIGNIFICANCE LEVEL  .683091E-01
```

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC	SIGNIF LEVEL
***	*******	***	***	***********	***********	***********	***********
1	LNRDBD	56	0	-.5503796E-01	.1556717E-01	-3.535515	.9265514E-03
2	LNGNPD	57	0	.1977771	.4121052E-01	4.799190	.1653468E-04
3	LNIMPHD	47	1	-1.587393	.9565336	-1.659527	.1036687
4	LNOILHD	48	1	-.2698561	1.742826	-.1548382	.8776119
5	LNCPID	50	1	-.5445094	.1137737	-4.785899	.1728617E-04
6	LNM1AD	51	1	.5970794	.8397281E-01	7.110390	.9279076E-08
7	INSPDOTD	49	0	-1.217629	.4389419	-2.774010	.7917564E-02
8	DUMMY	15	0	-.2221531E-01	.6994985E-02	-3.175891	.2637818E-02

$(RHO)_1 = 0.576509$ $(RHO)_2 = 0.232635$

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