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NOMINAL DEMAND POLICY AND OUTPUT IN KOREA: AN EMPIRICAL STUDY

I. Introduction

In recent years the "New Classical" Approach, which incorporates features of the natural rate hypothesis and the rational expectations hypothesis in macroeconomic models, has led to the key propositions about stabilization policy, which can be summarized as follows: (i) Anticipated movements in nominal variables will have no real effects. Unanticipated changes do affect real output, but stochastic variations of policy variables merely raise cyclical output fluctuations. (ii) Counter Cyclical monetary policy changes, for example, are ineffective in stabilizing real output.[1] This epuilibrium business cycle approach has been developed in studies such as Lucas(1972, 1973), Sargent and Wallace (1975), and Barro (1976) and others.[2]

In view of its profound policy implications, one deterministic policy rule should be pursued. Thus, the empirical validity of policy ineffectiveness proposition is perhaps an important issue

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1) In the Lucas model where economic agents respond only to relative price movements and are spatially isolated, informational asymmetries cause them to confuse relative price movements with nominal price movements. Using rational expect ations in forming their price forecasts, any systematic component of price movements will be forecasted rationally in the sense of Muth (1961). Thus, the nature of the Lucas supply function insures that theses anticipated price changes will not affect supply of output.

2) However, equilibrium models of the business cycle could not explain the persistance of the typical business cycle, see Modigliani (1977). On the other hand, these theories focus only upon one of possible multiequilibria of rational expectations. In this sense, other equilibria are typically not considered. In some of them, output is positively correlated; in others the correlation is negative. For a further elaboration of this important issue, see Farmer and Woodford (1984).

in new classical macroeconomics. In this sense, Barro (1977, 1978), Barro and Rush (1980) and others have provided empirical support for the neutrality hypothesis that only unanticipated money growth matters. [3]

Curiously almost all formal testing has been focused upon the United States. It is the purpose of this paper to investigate for Korea the effects of unanticipated and anticipated nominal demand policy on real output over the quarterly period 1961 : 1 through 1984 : Ⅳ.

The paper is organized as follows. Section briefly outlines the procedure to specify a forecasting equation for nominal income growth as a proxy for policy instruments. The empirical results of unanticipated and anticipated nominal demand policy variables on real output are then presented. A summary and some concluding remarks are provided in the final section.

Ⅱ. Specification of the Nominal GNP Growth Equation

Following Gordon (1979) and Grossman (1079) nominal Gross National Product (GNP) growth is used as a proxy for policy instruments to investigate the hypothesis that ony unanticipated movements in nominal demand policy cause the short-run output fluctuations in Korea. This variable is chosen here (instead of money growth) for three main reasons. First, although the assumption is questionable that nominal GNP growth is exogenous, results with nominal GNP growth as a nominal demand variable are consistent with money growth results in the United States.[4] Second, the time series of the money growth rate has erraticaly fluctuated during a period to be considered. Finally the data for predictors of the central bank's money reaction function are not available at this moment.

Nominal GNP growth must be specified so as to make the hypothetical distinction between unanticipated and anticipated components empirically meaningful. A number of potential strategies are available for specifying a forecasting model for nominal GNP growth. Without loss of generality

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3) Leiderman (1980) provided strong support for the view that anticipated monetary policy has no real effects. However, Mishkin found that his testing results were sensitive to the lag length used. When twenty lags were considered the neutrality hypothisis was rejected, while with seven lags used it was not.

4) See Mishkin (1983, p. 133).

at least four strategies are here considered. First, current information for the relevant predictors should be omitted from the forecasting equation since only information at time t−1 is known when expectations are formed at time t. Second, the variables employed as predictors of nominal GNP growth should also explain a sizable proportion of the total variation in the dependent variable. Third, the forecast errors from the regression equation (which are treated as a proxy for the unanticipated component in output equation) should be serially uncorrelated and also uncorrelated with some set of information avalilable at the time the forecast is made. Finally, an econometric relationship should remain stable in order to postulate that economic agents had sufficient knowledge about the structure of the equation.[5)]

In addition, in determining relevant predictors of nominal GNP growth and their lag specifications, the objective was basically to estimate a well−fitting nominal GNP growth equation with a white noise error process. This procedure is used to specify a forecasting model for Korean nominal GNP growth. GNP growth depends in an essenential manner on its own four quarterly lag values as well as three quarterly lag values of the rate of growth of the money supply broadly defined.

Using the quarterly data covering the period 1961 : I to 1984 IV, we estimated the nominal GNP growth (NGG) equation by Ordinary Least Squares (OLS). The results obtained are as follows:

$$\begin{aligned}(1)\ NGG_t = {} & \underset{(2.302)}{0.244}NGG_{t-1} + \underset{(5.948)}{0.609}NGG_{t-2} + \underset{(1.931)}{0.207}NGG_{t-3} - \underset{(1.800)}{0.187}NGG_{t-4} \\ & + \underset{(1.422)}{0.168}M2G_{t-1} - \underset{(1.284)}{0.233}M2G_{t-2} + \underset{(1.438)}{0.152}M2G_{t-3}\end{aligned}$$

$$\bar{R}^2=0.932\ \ SE=0.072\ \ DW=1.902\ \ Q(12)=9.71$$

Where NGG_t = the quarterly rate of growth in nominal GNP,

$M2G_t$ = the quarterly growth rate of M2,

SE = the standard error of estimate,

5) In a macromodel where the main interest is on the effect of monetary policy on output, Lucas' criticism (1976) implies that changes in policy variables will result in changes in the behavioral relation in estimated models.

DW=the Durbin−Watson statistic,

Q=the Ljung and Box adjusted Q−statistic.

The absolute values of t−statistics appear in the parentheses below the coefficient estimates. The set of independent variables explained a sizable and significant proportion of the total variation in the noiminal GNP growth.[6] On the other hand, an F−value for the joint hypothesis that all three M2G coefficients are zero is $F^3_{85}=2.14$, Which is significant at the 10 percent level. Efficient esimates and correct test statistics depend on the absence of significant serial correlation. To check for serial correlation, the Durbin−Watson statistic and the Q−statistic for the first twelve autocorrelations are presented.[7] The Q-statistic, which is approximately chi −square distributed, has a value of 9.71. Its corresponding p−value is 0.642, which means that there is a 62 percent chance that the residuals come from a white noise series. The reported Q statistic, therefore, suggests that the hypothesis that the first twelve autocorrelations are zero could not be rejected. a 93 percent of the total variation in the GNP growth was explained by the equation. Finally, the structural stability of the equation was examined by Chow test. With two subperiods of the data the Chow test result indicated that the hypothesis of structural stability would be accepted at the 25 percent level (F=0.342).[8]

Having provided some evidence for adequacy of the forecasting model, we now proceed to using these estimates for testing the policy ineffectiveness proposition that fluctuations of output around the natural level depend only on unanticipated nominal GNP growth.

Ⅲ. Anticipated versus Unanticipated Nominal GNP Growth and Real Output

The procedure employed here to investigate the effects of unanticipated and anticipated

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6) $F^6_{85}=180.0$, which is significant at the 25 percent level.

7) The Durbin−Watson statistic is known to be biased in the presence of a lagged dependent variable among the regressors.

8) Chow test is a typical form of F−test in which the stability of the regression coefficients over two subperiods of the data are tested. This is carried out by running the same regression model for the two subperiods, and comparing the sums of squared residuals.

movements in nominal GNP growth on real output is basically similar to those of Barro and Rush (1980) and Mishkin(1983). As seen in their framework, it is a key issue to decompose appropriately actual nominal GNP growth into unanticipated and anticipated parts.[9] As a proxy, these variables are represented respectively by fitted values and residuals from the forecasting equation(1). Using these components we shall estimate the following reduced form output equation and test for the statistical significance of the coefficients. For convenience, equation (1) can be slightly modified as

(2) $NGG_t=Z_{t-1}^{\delta}+V_t$

(3) $y_t=y_{nt}+\sum_{i=o}^{J}\beta_i\ (NGG_{t-i}-Z_{t-1i}^{\hat{\delta}})+\sum_{i=o}^{J}\ y_iZ_{t-1i}^{\hat{\delta}}+U_t$

(4) $U_t=\sum_{i=o}^{K}P_iU_{t-i}+\varepsilon_t$

$$\text{Chow test}=\left\{\frac{SSR_0-SSR_1}{SSR_1+SSR_2}\right\}\left\{\frac{T-2k}{k}\right\}\sim\sim\sim F(K,T-2k)$$

where

SSR_0=the sum of squared residuals from the entire sample period regression (1961 : I to 1984 : IV),

SSR_1=the sum of squared residuals from the first sample period regression (1961 : I to 1973 : IV),

SSR_2=the sum of squared residuals from the second sample period regression (1974 : I to 1984 : IV),

T=the number of total observations,

k=the number of coefficients to be estimated.

9) The forecasting equation (1) is assumed to be identified explicitly with agents' expectations of nominal GNP growth rate as nominal demand policy. However, some studies made an attempt to deal with a mismeasurement problem on the tests of hypotheses of the new classical macroeconomics, For more details, see Frydman and Rappoport (1985a, 1985b). Frydman and Rappoport (1985a) show that the measurement error of rational expectations leads to inconsistent estimates and their invalid test procedures. In their sequel paper (1985b), they constructed a test of the "Irrelevance of the Anticipated-Unanticipated Distinction" hypothesis and found for the Unit-ed States that there was no distinction between the output effects of anticipated and unanticipatod money growth.

where NGG_t= the nominal GNP growth rate,

Z_{t-1}= a vector of predictors used to forecast NGG which are known at time t,

δ= a vector of cofficients,

V_t=an unpredictable shock which is assumed to be uncorrelated with some set of information available at time t and also serially uncorrelated,

y_t= the natural log of real output (GNP),

β_1= a vector of coefficients,

y_1= a vector of coefficients,

u_t= a stochastic error term which is assumed to be serially correlated,

ρ_i= autoregressive coefficients.

ε_t= a white noise error term.

The regression cannot be carried out until a proxy is found for the natural rate of output. As to natural level of output, a proxy is assumed to be a constant and linear time trend.[10] According to equilibrium models of the business cycle, any deviation of output from the natural rate is represented by a serially uncorrelated stochastic process with mean zero.[11] However, it is hard to explain the observed persistent movements in output and unemployment with the models. Hence, for empirical work rather than any theoretical justification, lag values of U_t term in equation (3) are simply added to the natural rate so that the natural rate of output is shown to be itself serially correlated. Thus, the natural rate can be specified as follows:

(5) $y_{nt}= C+ {}_t TIME+\sum^{K}_{i=o} p_i U_{t-i}$

10) Barro and Mishkin used this type of the nature rate of output. Tech-nological progress can be considered as another hypothetical determinant of the natural rate of output. Dornbusch and Fischer (1984) suggest that the use of labor productivity as a proxy for technological progress.

11) Because the only source of any deviation of output from the natural rate is a random forecast error, the time series of output must be uncorrelated. In other words, since a positive forecast error at time t does not convey any information about the next forecast error, the guess for the next period's output stays still at the natural rate.

A two−step procedure was used in estimating equations (3) and (4). The first step is to estimate equation (2) by OLS. The results are reported in the previous section. This step decomposes actual nominal GNP growth NGG_t into $NGG_t - Z_{t-1}\hat{\delta}$ and $Z_{t-1}\hat{\delta}$. Substituting these componentsinto equation (3), the second step is to estimate equations (3) and (4) jointly.

In the second step equation (3) is estimated using the Almon polynomial distributed lags. [12] Since we have to specify a priori the choice of the length of lag and the degree of the polynomial, several important decisions had to be made. The first decision concerns the length of lags on the policy variables − the size of J in equation (3). As in Barro (1977,1978) and Barro and Rush(1980), one possibility for specifying the length of lag is to keep on extending the length of lag until the coefficient of additional lag variable is no longer statistically significant. On the basis of such a criterion, 6lags of each variable were empirically appropriate for Korean data.

The second decision is also to specify a priori the degree of the pol-ynomial. We used a cubic polynomial for lag coefficients, while Mishkin used a fourth−degree polynomial lag. However, in contrast to Mishkin, no end point constraints were not imposed, as recommended by Schmidt and Waud (1973), in order to avoid a potential bias. The final decision made concerned the determination of K, the order of potential serial correlation is the reduced form output equation. We used a third−order autoregressive process since the fourth autoregressive coefficient did not appear to be sizable or significant when added to equation (3).[13] It is found for Korean data that the selection of a third−degree polynomial for six lag coefficients and of a third−order autoregressive process resulted in the highest value of $\bar{R}^2$, of the coefficient of determination adjusted for the number of degrees of freedom.[14]

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12) The least squares estimates are not sufficiently precise in the case of a high degree of multicollinearity in the regressor variables. As a result, most of the estimated regression coefficients might be statistically insignificant, and powerful inferences concerning the true weights would not be possible. In such a case, a solution to this problem is to introduce the Almon lag tech-nipue.

13) Mishkin (1983) used a fourth−order autoregressive process, while Barro and Rush set K at 2.

14) Such a technique may not be without defects, for the differences between several values of $\bar{R}^2$ may be very small. Nevertheless, one or the other of these criteria, plus other considerations may help in choosing the "best" lag for the problem at hand.

The regression results obtained are displayed in Table 1. Note that additional lag values of anticipated and unanticipated parts are shown to be insignificant when added to the output equation. The residuals from the estimated output equation do not show any significant pattern of further serial correlation with the Durbin–Watson statistic of 1.899. In addition, a P–value for Box and Pierce test indicates that there is a 56 percent chance for the first 24 autocorrelations are a white noise series. The output equation explained a 99.7 percent of the total variation in the real output. The effect of a time trend appears to be sizable and significant, and the coefficient estimate of 0.022 amounts to about 3 times that of 0.008 reported in Mishkin' s study for the United States.

Contrary to the results for the United States, both anticipated and unanticipated nominal GNP growth movements have not only sizable but also significant effects on the short–run behavior of real output. The pattern of the unanticipated part has a positive contemporaneous response but negative persisting responses. The sum of impact effects of unanticipated movements is negative, which is contrary to what might be expected. While the total effects of the anticipated component are, as expected, positive. An interesting result is that the anticipated part has a stronger contemporaneous response on real output than the initial impact effect of the unanticipated part. In sum, the empirical results presented here for Korea strongly reject the claim of the policy ineffectiveness proposition that only unanticipated policy shocks matter. We, therefore, infer that the neu-trality hypothesis does not hold in Korea, rather the results obtained provide strong support for the Keynesian view that activist demand policy can play a significant role in determining the course of the business cycle.[15]

Ⅳ. Concluding Remarks

This paper has examined the important issue of whether unanticipated demand policy matters for Korea over the quarterly period 1961 : I to 1984 : Ⅳ. We specified an equation to predict nominal GNP growth. Anticipated movements of GNP growth were hypothesized as the fitted values from the forecasting equation, whereas the residuals were taken to represent the unanticipated

15) The Korean results are consistent with the macroeconomic contracting mod-els of Fischer (1977), phelps and Taylor (1977) and Taylor (1979).

Table 1. Effects of Unanticpated and Anticipated Nominal GNP Growth on Real Output

c=0.7051 (254.53)**	τ=0.0224 (116.07)**
ρ_1=0.5752 (4.69)**	ρ_2=0.5983 (4.66)**
	ρ_3=-0.3173 (2.65)**
β_0= 0.2855 (4.68)**	γ_0= 0.7218 (4.47)**
β_1=-0.1603 (2.08)**	γ_1= 0.4771 (5.68)**
β_2=-0.3734 (4.04)**	γ_2= 0.1732 (1.63)
β_3=-0.4096 (4.91)**	γ_3=-0.0952 (1.10)
β_4=-0.3245 (3.80)**	γ_4=-0.2329 (2.76)**
β_5=-0.1737 (2.03)**	γ_5=-0.1453 (1.88)*
β_6=-0.0129 (0.15)	γ_6= 0.2626 (2.50)**

$\overline{R^2}$=0.997 SE=0.0233 DW=1.889 Q(6)=4.15 Q(24)=22.25

Note : The absolute values of t-statistics appear in the parentheses.
* Significant at the 5 percent level.
** Significant at the 1 percent level.

part of nominal GNP growth. The output equation was then specified in which anticipated and unanticipated nominal GNP growth were treated as explanatory variables. A proxy for the natural level of output is also included as an additional influence on supply of real output. The contemporaneous and the first quarterly lag value of anticipated nominal GNP growth are shown to have considerable real effects on output.

The empirical results reported here strongly suggest that both components of nominal demand policy can influence the short-run behavior of real output. That is, a contemporaneous and six quarterly lag values of anticipated nominal GNP growth can induce powerfully positive deviations of real output from the natural rate, whereas all lag values of the unanticipated part have negative output effects which are contrary to what might be exspected. It can be said that systematic demand policy does have a powerful role to play in stabilizing real output in Korea due to the presence of wages or price rigidities.

APPENDIX

The Data

The definitions and the sources of the data used in this paper are as follows:

NGG=average growth rate (quarterly rate) of nominal GNP as percent changes to the same quarter of the previous year.

Sources : The Bank of Korea, *National Income*, 1974, and *Quarterly GNP (Base year : 1980)*, unpublished, 1986.

M2G=quarterly growth rate (end of period) of M2 as percent changes to the same quarter of the previous year.

Sources : The Bank of korea, *Money and Banking Statistics*, 1984, and *Monthly Bulletin*, January 1986.

y_t=real GNP (billion won 1980) adjusted seasonally.

Sources : The Bank of Korea, *National Income*, 1974, and *Quarterly GNP (Basic year : 1980)*, unpublished, 1986.

Note : The quarterly real GNP data for period 1960 : I−1969 : IV are based on a 1970 constant price. Meanwhile, the data covering the period 1970 : I to 1984 : IV are based on a 1980 constant price. Therefore, the former data used here were transformed into real GNP series at a 1980 market price. Then the data for the entire sample period were adjusted seasonally by using a xll computer program.

REFERENCES

Attfield, Clifford L, F., "An Analysis of the Implications of Omitting Variables from the Monetary Growth Epuation in a Model of Real output and Unanticipated Money Growth," *European Economic Review*, December 1983, 281−290.

Barro, Robert J., "Unanticipated Money Growth and Unemployment in the United States," *American Economic Review*, March 1977, 101−225.

------, "Unanticpated Money, Output and the Price Level in the United States," *Journal of*

Political Economy, August 1978, 549–580.

------ and Mark Rush, "Unanticipated Money and Economic Activity," in *Rational Expectations and Economic Policy*, Ed. by S. Fischer,Chicago: University of Chicago Press, 1980.

Begg, D. K. H., *The Rational Expectations Revolution in Macroeconomics: Theories and Evidence*, Baltimore, Maryland: The John Hopkins University Press, 1982.

Dornbusch, Rodiger and Stanley Fischer, *Macroeconomics, 3rd ed.*, New York: McGraw–Hill Book Company, 1984.

Farmer, Roger E. A. and Michael Woodford, "Self–Fulfilling Prophecies and the Business Cycle," mimeo, University of Pennsylvania, April 1984.

Fischer, Stanley, "Long–Term Contracts, Rational Expectations and the Optimal Money Supply," *Journal of Political Economy, February 1977, 191–205.*

Frydman, Roman and peter Rappoport, "An Examination of Econometric Test of the Propositions centered to the New Classical Macroeconomics", C.V. Starr Center, New York University, *Economic Research Report* #85–04, January 1985a.

------, "Empirical Investigation of the Irrelevance of the Distinction Between Anticipated and Unanticipated Money in Explaining Output," C,V. Starr Center, New York University, *Economic Research Report* #85–20, June 1985b.

Gordon, Robert J., "New Evidence That Fully Anticipated Monetary Changes Influence Real Output after All," *Discussion Paper* no. 369,Northwestern University, Center for mathematical Studies in Economics and Management Science, 1979.

Grossman, Jacob, "Nominal Demand Policy and Short–Run Fluctuations in Unemployment and Prices in the United States,"*Journal of Political Economy*, October 1979, 1063–1085.

Leiderman, Leonard, "Macroeconometric Testing of the Rational Expectations and Structural Neutrality Hypothesis for the United States," *Journal of Monetary Economics*, January 1980, 69–82.

Lucas, Robert E., Jr., "Expectations and the Neutrality of Moner,"*Journal of Economic Theory*, April 1972, 103–124.

------, "Some International Evidence on Output–Inflation Trade–Offs", *American Economic Review*, June 1973, 326–334.

------, "Econometric Policy Evaluation: A Critipue," in *Studies in Business–Cycle Theory*,

by R. E. Lucas, 104−130, Cambridge: The MIT Press, 1981.

Mishkin, Frederic S., *A Rational Expectations Approach to Mac-roeconometrics,* Chicago : University of Chicago Press, 1983.

Modigliani, Franco, "The Monetarist Controversy or, Should We Forsake Stabilzation Policies?" *American Economic Review,* March 1977, 1−19.

Muth, John F., "Rational Expectations and the Theory of Price Movements," *Econometrica,* July 1961, 315−335.

Phelps, Edmund S. and John B. Taylor, "Stabilizing Properties of Monetary Policy under Rational Expectations," *Journal of Political Economy,* February 1977, 163−190.

Sargent, Thomas J., *Macroeconomic Theory,* New York: Academic Press, Inc., 1979.

------ and Neil Wallace, "Rational Expectations and the Theory of Econ-omic policy," *Journal of Monetary Economics,* April 1975, 169−184.

Schmidt, peter and Roger N. Waud, "The Almon Lag Technique and the Monetary versus Fisical Policy Debate," *Journal of the American Sta-tistical Association,* March 1973, 11−19.

Taylor, John B., "Aggregate Dynamics and Staggered Contracts," *Journal of Political Economy,* February 1980, 1−23.

Vandaele, Walter, *Applied Time Series and Box−Jenkins Model,* New York: Academic Press, Inc., 1983.

國文抄錄

名目需要政策과 實質國民生産：實證的 分析

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장래에 대한 豫想 또는 豫測이 經濟行爲의 意思決定에 있어서 미치는 영향은 크다 할 것이다. 合理的 期待假說은 情報(inforamation)와 合理的 豫想의 개념을 도입하여 케인즈이후 巨視經濟學에 微視的 基礎를 제공하였으며 巨視分析에 크나 큰 공헌을 하였다.

經濟主體들이 豫想을 形成할 때 주어진 모든 情報를 共有하고 効率的으로 이용하며, 每期마다 市場이 均衡되도록 價格이나 資金의 完全伸縮性을 인정하고, 口民生産이 루카스(Lucas) 供給函數形態를 취한다는 것을 전제로한 合理的 期待模型에 따르면 總需要를 관리하는 政府의 經濟安定化政策이 長期에서 뿐만 아니라 短期에 있어서도 失業率이나 實質 GNP와 같은 實質變數에 아무런 영향을 주지 못한다는, 이른바 政策無力性命題를 定立하였다. 바꾸어 말하면, 貨幣供給量이 변화하는 需要政策이 經濟主體들에 의해 合理的으로 期待될 때 豫想된 部分은 實質國民生産 (또는 潛在國民生産 — 實際國民生産)에 영향을 전혀 미치지 않는 반면, 豫想되지 못한 部分만이 일시적 實質効果(random effect)를 갖는다고 한다.

여기서 다루고자 하는 주제는 體係的인 名目需要政策의 豫想되지 않는 部分만이 實質GNP에 영향을 미치고 이미 豫測된 部分은 實質効果가 없는 가를 우리나라의 資料(1961 : Ⅰ—1984 : Ⅳ)로 檢證하는 것이다. 名目所得增加率을 需要管理政策變數로 代用하여 分析한 결과 豫想된 部分과 豫測되지 못한 部分 모두가 實質國民生産에 영향을 미치는 것으로 나타났다.

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