

# The Controllability of the Monetary Base:

## The Central Bank's Reaction Function in Korea

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### I. Introduction

In a developing economy, monetary policy consists primarily of varying degrees of control over the aggregate supply of money. Other alternative price instruments, such as interest rates, are usually inflexible and seldom reflect money market conditions. Thus, controlling the monetary growth to obtain price stability and economic growth is the prime task for the monetary policy in Korea.

In order to control the growth of the money stock, the monetary authority would specify a desired level of the money stock, forecast the money multiplier for that period, and adjust the monetary base appropriately. Thus, it is evident that the degree of control is directly related to how well the multiplier can be forecast and to how well the monetary authorities can control the base, given the proper choice of a monetary indicator.

As one of the primary elements of the money supply, the monetary base seems to play a relatively important role in determining monetary growth in Korea, where the reserve ratio and currency ratio are relatively high. Examining the behavior of the monetary base seems to be important for understanding the ability of the monetary authorities to control the money supply.

The present study has attempted to investigate the ability of the monetary authorities in Korea to control the growth of the

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monetary base during the 1970's. In order to check the controllability of the monetary base, the following questions will be examined:

1. What are the main determinants of the monetary base?
2. How much can the monetary authority in Korea control or offset the variables in the reaction function?

With respect to the question of the controllability of the monetary base in an open economy such as that of Korea, it seems important to analyze the sterilization behavior of the monetary authority with respect to changes in foreign reserves. In order to control the monetary base, the monetary authority must offset movements in the uncontrolled component of the monetary base through changes in the controlled component. For example, if the Central Bank is to maintain control of the monetary base for the pursuit of domestic goals, the impact of foreign reserves on the monetary base must be sterilized by using sterilization policy instruments. To investigate the degree to which the payment imbalances influence the ability of the monetary authority to control the money supply, we will examine the following question: Can the monetary authority sterilize the impact of an outflow or inflow of foreign reserve on the monetary base and money supply?

## II. Specification of the Central Bank's Reaction Function

The monetary base, which reflects changes on the asset side of the balance sheet of the Central Bank, is determined by the interaction of demand pressures for the base and the behavior of the Central Bank to accommodate those pressures and supply high powered money. The accommodation pressures mainly come from the fiscal (government) sector, the foreign sector and cost-push variables. The supply of the monetary base is determined by the reaction of the Central Bank to those pressures.

Thus, behavior of the monetary base could be captured in the reaction function of the monetary authority. The reaction function includes a number of variables which influence the course of monetary policy such as objective variables for stabilization policies, the state of the economy, and sources of pressure for monetary accommodation if the stabilization authorities are assumed to react endogenously to the course of the economy in the

systematic reaction patterns.<sup>1</sup> (A review of previous studies of the Central Bank's reaction function is included in footnote 1, below).

In the Central Bank's balance sheet, the main sources of monetary base growth are divided into the following subsectors: credit to the government and government agents, credit to the private banking sector, and inflows of net foreign assets. Thus, the determinants of the monetary base are specified by examining the main determinants of each of these three subsectors separately, which together push the Central Bank to accelerate the growth of the monetary base.

#### a. Government Sector

The major determinant of credit to the government and the

1 A great many studies have attempted to estimate the reaction function of the Central Bank in order to discover the politico-economic determinants of the behavior of the money stock. The earliest was John Wood (1967). Since Wood, a number of attempts have been made to fit the Central Bank reaction function. Most previous policy reaction functions have used either an explicit constrained optimization model or an ad hoc approach. In the ad hoc approach, the reaction function is specified as a linear function of variables which are deemed to be theoretically and/or historically plausible determinants of policy under the assumption that stabilization authorities were reacting endogenously to the course of the economy.

Optimizing Method: The implied reaction usually takes the form of a linear function of target variables, measured as deviation from their optimal levels, as well as exogenous variables which were included in the constraint equations. See, John Wood, "A Model of Federal Reserve Behavior," in *Monetary Process and Policy: A Symposium*. Homewood, IL: Richard D. Irwin, Inc, 1967, pp. 135-166; P. D. Jonson, "Stabilization Policy in Australia: An Objective Analysis," *The Manchester School* 42, No. 3 (September 1974): 259-276; and Robert Fair, "The Sensitivity of Fiscal Policy Effects to Assumption About the Behavior of the Federal Reserve," Cowels Foundation Discussion Paper No. 446, Cambridge, Mass.: Yale University Press, 1977.

Ad Hoc Specification: this approach is ad hoc in the sense that no pretense is made of using an optimization procedure. The assumption is made that the control variable is a linear function of variables which are likely determinants, either in view of the history of policy or implied by economic or political economy theory. Most studies include the usual stabilization goals along with a lagged regressand term to capture a partial adjustment process and the effect from omitted variables. The regression equation reveals that measures of inflation, unemployment, growth and the balance of payments are included as explanatory variables in some form in most of the studies. Choice of dependent variables (the money supply, high-powered money, the monetary base or the domestic component of the monetary base) was based on either the overall purpose of the author's study, or his belief regarding the nature of the monetary aggregate which the authority has actually controlled. See Thomas Havrilesky, "A Test of Monetary Policy Action," *Journal of Political Economy* 75 (June 1967): 299-304; Michael Keran and Christopher Babb, "An Explanation of Federal Reserve Actions:

government agency is the budget deficit. In a developing economy such as Korea's, there exist structural characteristics which may make the Central Bank accommodate budget deficits more than in developed nations.

First, capital markets in LDC's are relatively underdeveloped, so the ability of the government to finance budget deficits through government bonds seems relatively limited. Financing deficits relies heavily on borrowing from the Central Bank and creating money. Second, the degree of independence of the Central Bank is relatively small since monetary policy is carried out within the framework of a government financial stabilization program directed by the financial minister. A monetary authority dominated by the financial minister might be susceptible to this pressure.

For these reasons, budget deficits in Korea are more likely to be accommodated to a greater extent than in advanced countries.

### B. *Private Banking Sector*

The private banking sector is a relatively flexible sector which the monetary authorities are able to control. Thus, credit to the private banking sector is used as a major instrument of monetary policy. Because of its relative flexibility and importance as a policy instrument, the determinants of credit to the private banking sector rely on many factors such as the state of the economy

1933-1968," *Federal Reserve Bank of St. Louis Review* 51, No. 7 (July 1969): 7-20; Manfred Willms, "Controlling Money in an Open Economy: The German Case," *Federal Reserve Bank of St. Louis Review* (April 1971): 10-27; Victor Argy and Pentti J.K. Kouri, "Sterilization Policies and the Volatility in International Reserves," in *National Monetary Policies and the International Monetary System*, Aliber, Robert, ed., Chicago: University of Chicago Press, 1974, pp. 209-229; Richard Froyen, "The Determinants of the Federal Reserve Discount Rate Policy," *Southern Economic Journal* 42, No. 2 (October 1975): 193-200; Norman C. Miller and Sherry S. Askin, "Monetary Policy and the Balance of Payments in Brazil and Chile," *Journal of Money, Credit and Banking* 8, No. 1 (May 1976): 227-238; Richard J. Herring and Richard C. Marston, *The National Monetary Policies and International Financial Markets*, Amsterdam: North-Holland Press, 1977; Robert Barro, "Unanticipated Money, Output, and the Price Level in the United States," *Journal of Political Economy* (August 1978); and Thomas D. Willett and Leroy O. Laney, "Monetarism, Budget Deficit and Wage-Push Inflation: The Cases of Italy and the U.K.," *Banca Nazionale del Lavoro Quarterly Review* 127 (December 1978): 315-331.

and cost-push variables, and may reflect the policy objectives as well.

The credit to the private banking sector relies primarily on the demand for banking loans, which may be divided into preferential and common loans. Preferential loans are policy-oriented loans which provide advantages in terms of the cost of borrowing and accessibility. Export credit has a large share in it. The demand for preferential loans, which relies heavily on export volume, seems to be easily accommodated and accelerates the monetary base. Common loans consist of short-run commercial loans.

In Korea, business firms depend heavily on the commercial banking sector for their working capital. The commercial banking sector in turn relies heavily on borrowing from the Central Bank for their loanable funds to satisfy excess credit demand. The Central Bank can exercise some control over commercial loans by limiting borrowing from the Central Bank. Therefore, credit to commercial loans can be used as an important policy instrument to control or offset the independent influences from other sectors of the monetary base. This offsetting behavior of the monetary authority relies on the policy intentions of the economic objectives and the policy reactions to the change of economic conditions.

Along with this, cost push factors originate from both domestic and foreign markets. The increase of domestic wages and imported intermediate goods' prices could affect the growth of the monetary base, primarily through credit to the private banking sector.

In Korea, imported intermediate goods, which constitute a large share of total imports, are one of the major factors used in the production process. An increase in imported goods' prices raises factor costs, and the subsequent increase of production cost, will require more working capital for business firms. Since business firms in Korea heavily rely on the commercial banking sector for their working capital, the demand for bank loans will increase. Business firms, particularly export businesses in Korea, rely heavily on imported intermediate goods in the production process. If required expansion of working capital can not be financed through bank loans, this will result in reducing production and exports. This, in turn, reduces the growth rate, which

depends on the export volume,<sup>2</sup> and increases the unemployment rate, which depends on the growth rate.

Therefore, the increase of imported goods' prices may give rise to pressures for accommodation, which would accelerate the growth of the monetary base (Moore, 1980, 1981).

Domestic wage-push would also influence the monetary base through the same channels as the increase of import prices (Willett and Laney, 1978). However, in Korea, the existence of the excess supply of labor and the weakness of labor unions might prevent large increases of money wages, which would cause such pressures. Thus, wage-push seems likely to be less important for Korea than for countries with stronger labor unions (Willett and Laney, 1978). A possible exception might be the period in which a large migration of labor to the Middle East occurred after the 1970's.<sup>3</sup>

### *C. Foreign Sector*

The flow of foreign assets reflects the condition of the balance of payments, which, in turn, depends upon trade conditions and capital flows.

Through an export-oriented development strategy, the Korean economy relies heavily on the foreign economy in order to export its output and import intermediate capital goods and foreign capital. Thus, not surprisingly, the reliance of the Korean economy on the foreign sector is great.

Foreign reserve flows originate from the change of the balance of payments, are highly volatile, and seem hard to predict. They may significantly influence the growth of the monetary base in Korea.

<sup>2</sup> Exports are one of the major determinants of GNP and it determines the economic cycle in Korea.

<sup>3</sup> In Korea, the rate of growth of wages in 1974 rapidly increased by 31.9% and this growth rate was almost double the previous growth rates. See Bhalla (1981), p. 68 (table 3.9).

### III. Description of the Model

From the previous discussions, the basic equation investigated specifies the growth of the monetary base as a function of such variables, which are frequently offered as major causes of base growth: policy objective variables, the state of the economy and push variables.

Each of these variables is representative of a major explanation of the growth of the monetary base in Korea. In other words, those variables include factors claimed to be possible determinants of the Central Bank's behavior.

The functional form of the basic equation tested is as follows, with hypothesized signs indicated above the symbols:

$$(3.1) \quad \begin{array}{cccc} (+, -) & (+) & (+) & (-) \\ \Delta MB = f(\Delta MB(-1), \Delta NFA, \Delta DEF, \Delta PY(-1), \\ & (+) & (+) & (-) \\ & \Delta Y, \Delta PM(-1), \Delta RY(-1)), \end{array}$$

where  $\Delta MB$  is the difference in the monetary base tested,  $MB(-1)$  is the lagged monetary base, since one might expect the dependent variables to be explained to some extent in terms of their own prior movement (or partial adjustment process), and effects from omitted variables can operate through this term. Other symbols are used thusly:  $NFA$  = net foreign assets in the Central Bank;  $DEF$  = government budget deficit;  $PY(-1)$  = GNP deflator in the prior period;  $Y$  = real GNP;  $PM(-1)$  = the import prices in the prior period; and,  $RY(-1)$  = rate of change of non-agricultural real GNP over two previous periods.

One would expect the Central Bank to react to changes in the level of real economic activity in the economy. This reaction can take two forms. One is an accommodative response. For example, monetary policy may be relaxed and the monetary base may be increased in reaction to a perceived higher transaction demand for money balances when real economic activity is seen to be expanding. The other possible response is a countercyclical response that attempts to stimulate the economy with easier money when there is a considerable slack. For this reason, two activity variables are included in the equation. The first,  $\Delta Y$ , the differences in the

real GNP, is the accommodative one and is included to capture procyclical accommodative response of the Central Bank to incipient changes in economic activity. The second,  $\Delta RY(-1)$ , the difference of the percentage growth rate of nonagricultural real GNP over the two previous periods,  $\Delta RY(\text{na})(-1) - RY(\text{na})(-2)$ , may be interpreted as a proxy for cyclical variations in income and used as a proxy variable to measure the real output gap (actual output minus potential output) in the Korean economy. In Korea, the difficulty involved in measuring the potential output and also the conventional unemployment rate has little meaning given an excess supply of labor. Since one of the main policy objectives in Korea is high growth of real output and the condition of employment relies heavily on the growth rate of non-agricultural real output, we can expect that the Central Bank would have a countercyclical response to the movement of the growth rate of real GNP in the previous period. If, for example, the previous growth rate is slow, then monetary policy may be relaxed to stimulate the economic growth and prevent the increase of unemployment. Therefore, this variable,  $\Delta RY(-1)$ , would be used as a proxy variable to capture the countercyclical response of the Central Bank.

Through the last decades, maintaining price stability has been one of the most important objectives of monetary policy. The monetary authorities have paid considerable attention to the inflation rate. Thus,  $\Delta PY(-1)$ , defined as the change in the GNP deflator in the prior period, which is the most widely used indicator for inflation, is included to capture the Central Bank's response to accelerating or decelerating inflation in the reaction function. Some causality testing evidence points to causation running from changes<sup>4</sup> in the monetary base to price changes, but

4 Christopher Sims (1972) proposed testing for patterns of feedback between a pair of variables by running two regressions with each as dependent variable, and both leading and lagged values of the other as independent variable. Significant coefficients on the leading values of a right-hand variable indicate that it is endogenous, influenced by feedback from the left-hand variable. In Korea, empirical results show that coefficients on the leading values of a right-hand variable (the changes in the GNP deflator) is insignificant at the ninety-five percent level. See Christopher A. Sims, "Money, Income, and Causality," *American Economic Review* 62 (September 1972): 540-52, and Robert J. Gordon, "World Inflation and Monetary Accommodation in Eight Countries," *Brookings Papers on Economic Activity* 2 (1977): 423-424.

we believe that it is still reasonable to postulate some endogenous Central Bank response to changes in this variable if we consider the concern of Korea's monetary authorities over the price stability. In order to remove the problem of contemporaneous bidirectional causation, the previous period's, rather than the current period's price changes are used.

$\Delta PM(-1)$ , the changes in the import prices in the prior period, is defined as the product of a unit index of import price and exchange rate. This variable is included to capture the accommodation of cost-push pressures from the foreign sector.

Finally,  $\Delta DEF$  and  $\Delta NFA$  are the changes in the government budget deficit and the changes in net foreign assets of the Central Bank, respectively. Both are included to capture the reaction of the Central Bank to the accommodation pressures from the fiscal sector and the foreign sector. The Central Bank's reaction to the foreign pressures will be examined in more detail through an investigation of the sterilization coefficient of the Central Bank.

#### IV. Results

The OLS results of fitting seasonally adjusted quarterly data to the specification over the period 1971:2 to 1980:4,

(3.2.)

$$\begin{aligned} \Delta MB = & a_0 + a_1 \Delta MB(-1) + a_2 \Delta Y + a_3 \Delta RY(-1) \\ & + a_4 \Delta PY(-1) + a_5 \Delta PM(-1) + a_6 \Delta DEF + a_7 \Delta NFA + U, \end{aligned}$$

in which  $U$  represents the randomly distributed error term, are given in equation (1) of table 4.1.

Due to the multicollinearity among explanatory variables in the basic equation, specifically the relatively high correlation between the changes in the GNP deflator,  $\Delta PY(-1)$ , and the imported price variable,  $\Delta PM(-1)$ , we re-estimated the equations by dropping each of the multicorrelated variables from the basic equation and the results are reported in equation (2) and equation (3) of table 4.1.

In all the equations, a relatively high proportion (around eighty percent) of the variation in monetary base changes is ex-

**Table 4.1**  
**Regression Result:**

$$\text{Equation 1: } \Delta\text{MB} = A_0 + A_1\Delta\text{MB}(-1) + A_2\Delta Y + A_3\Delta\text{RY}(-1) \\ + A_4\Delta\text{PY}(-1) + A_5\Delta\text{PM}(-1) + A_6\Delta\text{DEF} + A_7\Delta\text{NFA} + U$$

Quarterly Data, 1971: 2 – 1980:4

Dependent Variable MB

Variable	Coefficient	T-Statistic	R <sup>2</sup>	$\bar{R}^2$
Constant	-44.7299	-0.767	0.857	0.825
MB(-1)	0.8390	6.460	SER	D-W
Y	0.5013	2.453	116.2	2.19
RY(-1)	0.0001	-1.638	F	
P(-1)	-8.1161	-2.547	26.5	
PM(-1)	6.8437	2.702		
DEF	0.1074	2.249		
NFA	0.2640	2.716		

**Table 4.1.(continued)**

$$\text{Equation 2: } \Delta\text{MB} = b_0 + b_1\Delta\text{MB}(-1) + b_2\Delta\text{RY}(-1) + b_3\Delta\text{PY}(-1) \\ + b_4\Delta\text{DEF} + b_5\Delta\text{NFA} + U$$

Quarterly Data, 1971:2 – 1980:4

Dependent Variable MB

Variable	Coefficient	T-Statistic	R <sup>2</sup>	$\bar{R}^2$
Constant	82.3499	2.005	0.807	0.778
MB(-1)	0.8211	7.545	SER	D-W
RY(-1)	-0.0001	-1.275	130.7	2.05
P(-1)	-3.9425	-2.235	F	
DEF	0.0903	2.837	27.6	
NFA	0.2631	2.837		

Table 4.1 (continued)

$$\text{Equation 3: } \Delta MB = C_0 + C_1 \Delta MB(-1) + C_2 \Delta Y + C_3 \Delta RY(-1) \\ + C_4 \Delta PM(-1) + C_5 \Delta DEF + C_6 \Delta NFA + U$$

Quarterly Data, 1971: 2 - 1980: 4

Dependent Variable MB

Variable	Coefficient	T-Statistic	R <sup>2</sup>	R <sup>2</sup>
Constant	-80.3826	-1.317	0.827	0.794
MB (-1)	0.6213	5.869	SER	D-W
Y	0.6128	2.836	125.8	2.21
RY (-1)	-0.0001	-1.577	F	
PM (-1)	1.8943	1.077	25.5	
DEF	0.0755	1.513		
NFA	0.1723	1.763		

Source: Economic Statistical Yearbook, Seoul: The Bank of Korea, various issues and International Financial Statistics, Washington, D.C.: International Monetary Fund, various issues.

plained by the overall specification. In equation (1), which includes all candidate variables, most independent variables except the countercyclical variable,  $\Delta RY(-1)$ , are quite significant (at the ninety-five percent significant level) as judged by T-statistics, and their signs support theoretical reasoning underlying their inclusion. Even though the countercyclical variable is still weakly significant (at the ninety percent significant level) with the proper sign, the estimated coefficient of this variable is so small and close to zero, that it implies that Korea's Central Bank reaction to the level of real economic activity is an accommodative response and the Central Bank supplies money primarily in order to support the level of economic activity. But the results of this equation must be interpreted with caution due to the multicollinearity among independent variables.

In equation (2), the import price and the real GNP terms which are significantly correlated with the price index (GNP deflator), are dropped from the basic equation. Although dropp-

ing those variables does not drastically change the overall results, some changes do occur. The overall proportion of variations in the dependent variables explained, measured by adjusted R-squared, is a little lower, seventy-eight percent instead of eighty-two percent. The degree of significance of the government budget deficit variable declines even though it is still closely significant at the ninety percent level. Along with this, the T-statistic on the countercyclical variable declines and is no longer significant, even at the ninety percent level. Other variables, however, such as the foreign reserve and the price index variable, are still highly significant with proper signs even though the degree of significance changes slightly for both. The significant and positive sign of the foreign reserve coefficient implies that foreign reserve inflows are not sterilized completely in Korea and that they affect the expansion of the monetary base to some extent, even though the magnitude does not seem to be very big. Thus, other things being equal, the monetary base may be expected to rise along with the growth of the foreign reserve. The coefficient of the foreign reserve change,  $\Delta NFA$ , is roughly 0.26. The elasticity of change in the monetary base with respect to change in the foreign reserve then becomes approximately 0.143 as calculated, based on the average value of  $\Delta NFA$  over the sample period.<sup>5</sup> This magnitude of elasticity indicates that a one percent increase in  $\Delta NFA$  will lead to a 0.14 percent increase in the monetary base when other things remain equal. In other words, a \$100 increase in foreign reserves will lead to a \$14 increase in the monetary base. This result indicates that the responsiveness of the

5 Quite frequently in economics and business one may be interested in interpreting the effects of percentage change of an independent variable on the dependent variable. The notion of the elasticity of a variable is used for this purpose. The elasticity of Y with respect to X (if assumed  $Y = b_1 X_1 + b_2 X_2$ ), for example, can be defined as the percentage change in Y divided by the percentage change in X. In general, elasticities are not constant but change when measured at different points along the regression line. The elasticities which are usually printed out by a computer program, are calculated at the point of the mean of each of the independent variables. For the coefficient,  $b_5$ , in equation (2) of table 4.1, the elasticity is evaluated as  $E = b_5 \times (\Delta NFA / \Delta MB) \approx (MB_t / MB_{t-1}) / (NFA_t / NFA_{t-1}) = 0.26 \times (142.09 / 257.97) = 0.143$ , where  $b_5$  is the coefficient for the foreign reserve variable and NFA and MB are the mean of each variable.  $E = 0.143$  indicates that a one percent increase in NFA will lead to a 0.143 percent increase in MB. In general, large elasticity implies that the dependent variable is very responsive to changes in the independent variable. See Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, Ibid., p. 91.

monetary base to the change in the foreign reserve in not very strong and the magnitude of impact on the base is significantly smaller than expected. It is widely said that developing countries lack developed financial institutions and, consequently, extensive open market operations, and reserve changes usually have a direct and immediate effect on their domestic liquidity. The correlation between a monetary base and foreign reserves in the developing countries is relatively high and generally, the elasticity is around unity (Bhalla, 1981). This result implies that a sterilization policy might work partially in Korea, though not perfectly.

The significant and negative sign of the lagged price index change,  $\Delta PY(-1)$ , indicates that Korea's monetary authorities are very concerned with maintaining the price stability.

As seen in equation (3), when the price index variable,  $\Delta PY(-1)$ , is dropped from the basic equation, the overall proportion of variations in the dependent variable explained, measured by R-squared, is still high (seventy-nine percent) and similar to when the price index is included. However, as a note of interest, the T-statistics on the import price,  $\Delta PM(-1)$ , decline drastically and become insignificant. Along with this, the degree of significance of the government budget deficit,  $\Delta DEF$ , declines and also becomes insignificant even at the ninety percent significance level. However, the margin from a critical level of significance is very small and it might indicate that this variable is loosely significant at the ninety percent level.

Even though T-statistics on the foreign reserve variable also decline, it is still quite significant at the ninety percent significance level and the magnitude of the coefficient declines to 0.17 compared to 0.26 in the previous equations (1) and (2). Other variables such as the pro-cycle variable, proxied by real income change, and the anticyle variable have similar results as in the previous equations.

On the basis of these statistical results, it would appear that the channel of validation of import prices is suspect and the result indicates that import price pressures are not the main cause of the monetary base increase. As previously discussed, the monetary base is determined by the interaction of the demand pressure for accommodation and the behavior of the Central Bank to accommodate those pressures and supply high powered money. Since

loanable funds in general are too limited to meet the excess demand in Korea; a deficiency of loanable funds might constrain the accommodation behavior of the Central Bank by limiting the supply of credit to the private banking sector. This supply side constraint might prevent the validation of import price pressure (cost pressure) significantly.

Aside from this, the results also show that there is no clear evidence of a significant countercyclical monetary policy. The monetary policy in Korea appears to focus primarily on supplying money in order to support the level of economic activity, particularly the fund for supporting the sustained high growth of the economy, which is one of the main policy objectives.

As seen from the results, the monetary authorities' concern over the price stability, another main policy objective in Korea, is very strong.

This empirical result failed to find support for the hypothesis that government budget deficits have a strong influence on the rate of monetary expansion. We find that the government deficit is only weakly significant (or insignificant) in determining the growth of the monetary base. This result might reflect the estimation period of this study which concentrates on the 1970's. In the 1970's, as the Korean economy developed rapidly, the tax structure changed significantly. In this period, the tax revenue significantly increased mainly due to progress in the tax system such as the establishment of the Office of the Tax Administration and the expansion of the tax base. Along with the change in tax structure, the economic policy emphasis in Korea shifted significantly in this period as the government placed more emphasis on economic stability (or price stability) than in the 1960's, based on their realization of the importance of stability for sustaining economic growth as shown in the previous period. In order to prevent the excess growth of money supply, in the 1970's the government depended increasingly on the issuance of government bonds instead of direct borrowing from the Bank of Korea, to finance budget deficits.<sup>6</sup> This shift in government policy, along

6 In the 1970's, the government depended increasingly on the issuance of Grain Bills, instead of direct borrowing from the Bank of Korea, to finance the ever-growing deficit in the Grain Management Fund. The deficit in the Grain Management Fund,

with the preferable change in the tax structure, might have helped to reduce the accommodation pressures from the fiscal sector over this period. Government budget deficits seem likely to have had a much greater influence on the monetary growth in the 1950's and 1960's.

Throughout the test, variables such as import price pressures and budget deficits were not very significant. The foreign reserve flow has a significant impact on the growth of the money base over this period, even though the magnitude of the impact is much smaller than expected if we consider the high reliance of the Korean economy on the foreign sector. This small magnitude would imply that the monetary authority in Korea could sterilize the impact of the foreign reserve flow on the base significantly, though not completely.

If the Central Bank is to maintain the control of the monetary base for the pursuit of domestic goals in an open economy such as Korea under the fixed exchange rate,<sup>7</sup> the impact of foreign reserves on the monetary base must be sterilized.

There are two possible ways in which change in foreign assets may influence the money supply. First, the monetary authorities may not be technically equipped with adequate monetary instruments to offset very large movements in the balance of payments. For example, the two most efficient instruments to sterilize movements in the balance of payments are open market operations and changes in the reserve requirement. Yet, in Korea, the use of open market operations are restricted by the small size of the capital markets, while reserve requirement changes have been used in a less flexible way. Other methods of sterilization, including ceilings on the lending of commercial banks, changes in discounts and advances to the private sector, and variations in deposits held by the government with the Central Bank are clum-

which is a major factor in the government budget deficit, is due to the adoption of dual prices for food grains.

7 The Korean government adopted a floating exchange rate system as a matter of principle. However, the government managed to fix the exchange rate against the U.S. dollar for most of the period during the last decade except for one major devaluation in 1974 from 400 Won: 1 dollar to 480 Won: 1 dollar. Therefore, the assumption of a fixed exchange rate is more realistic when we explain movements of foreign reserves for the last decade in the case of the Korean economy.

sy, less predictable in their effect, less flexible, and would constrain the ability of the Central Bank to sterilize foreign reserve flows. Second, in determining the appropriate change in the money supply, the authorities may take account of current developments in the balance of payments. In the first case, there are technical constraints on the means of controlling the money supply. In the second, the authorities may permit the money supply to respond to the balance of payments. While the higher degree of financial integration and capital mobility also might significantly constrain the sterilization ability of the authorities in developed countries, these factors do not seem important in Korea, where financial integration and capital mobility are severely limited.

The first technique used to test the extent of sterilization was to run regressions of the change in domestic assets against the change in net foreign assets, or, alternatively, the change in the money supply against the change in net foreign assets. It was thought that the coefficient of the change in net foreign assets might indicate the degree of sterilization. In the second type of equation, the coefficient of the change in net foreign assets might directly measure the responsiveness of the money supply to the payments balance.<sup>8</sup> It is important to recognize, however, that one cannot make inferences about a country's ability or desire to sterilize simply from looking at the correlations between reserve changes and money supply. Finding no relationship could be consistent either with complete sterilization and strong domestic monetary control, or with such high international capital mobility that any attempt to vary the domestic money supply independently is completely offset by changes in international reserves, leaving

8 Victor Argy and Pentti J.K. Kouri, "Sterilization Policies and the Volatility in International Reserves," in Robert Aliber, ed., *National Monetary Policies and the International Monetary System*, Chicago: University of Chicago Press, 1974, pp. 209-229; Richard J. Herring and Richard C. Marston, *The National Monetary Policies and International Financial Market*, Amsterdam: North-Holland Press, 1977; Thomas D. Willett and Leroy O. Laney, "The International Liquidity Explosion and Worldwide Inflation: The Evidence From Sterilization Coefficient Estimates," *Journal of International Money and Finance* (1982): 141-152; Norman C. Miller and Sherry S. Askin, "Monetary Policy and the Balance of Payments in Brazil and Chile," *Journal of Money, Credit and Banking* 8, No. 1 (May 1976): 227-238; and, Manfred Willms, "Controlling Money in an Open Economy: The German Case," Federal Reserve Bank of St. Louis, *Review* (April 1971): 10-27.

no scope for domestic monetary control. The way to attempt to solve this problem is to estimate what monetary growth would have been in the absence of international consideration. Fortunately, this is what our estimates of the determinants of monetary growth provides. Thus, the use of a number of independent variables in our equation gives us one way of handling this problem.

According to the results obtained from the reaction function of the Central Bank, the coefficient of the foreign reserve change,  $\Delta NFA$ , is roughly 0.26. The elasticity of change in the monetary base, with respect to change in the foreign reserve, then becomes approximately 0.143 as calculated based on the average value of  $NFA$  over the sample period. This result indicates that the monetary authorities in Korea, on the average, offset in the current period approximately eighty-five percent of the change in the foreign reserve flow by using sterilization policy instruments during the 1970's.<sup>9</sup>

Overall, these results suggest that while international influences are far from trivial and are worthy of being deemed a significant factor, the expansion of the monetary base in Korea over this period might have been influenced primarily by domestic considerations, in spite of Korea's large foreign sector and technical constraints on sterilization. Korea's monetary authorities have considerably more room to control the monetary base significantly by proper operation procedures.

## V. Summary and Conclusion

In order to examine the controllability of the monetary base, first we defined the main policy determinants of the monetary base, and then examined the Central Bank's ability to sterilize the

<sup>9</sup> There is considerable empirical evidence that most industrial countries do practice a substantial amount of partial sterilization and the results of the recent sterilization coefficient estimates for the major industrial countries are summarized in Willett and Laney, (1982), *Ibid.*, table 1, pp. 144-145. In developing countries, the sterilization equations for Brazil and Chile are reported in Miller and Askin (1976), *Ibid.*, p. 232. Their results are that the sterilization coefficients for both countries are significantly different from zero and not significantly different from minus unity. That is, Brazil and Chile appear to sterilize completely.

impact of the major determinants on the monetary base, namely, the foreign reserve flow. We investigated the reaction function of the Central Bank which specifies the growth of the monetary base as a function of policy objective variables, the state of the economy, and push variables. Frequently offered as causes of monetary base growth, each of these variables is representative of a major explanation of this growth. In other words, each variable is a possible determinant of the Central Bank's behavior. Throughout the test, the most reliable sources of accommodation pressures, other than the policy target variables, were the changes in the foreign reserve flow. Meanwhile, on the basis of statistical results, it appeared that the channel of validation for import prices was suspect, and import price pressures were not the main cause of the monetary base increase. If we consider the heavy reliance of the Korean economy on the imported intermediate goods in the production process, this result is a note of interest. Aside from this, empirical results failed to find support for the hypothesis that government budget deficits had a strong influence on the rate of monetary expansion. We found that the government deficit was only weakly significant in determining the growth of the monetary base. This result might reflect the estimation period of this study which concentrated on the 1970's. In this period, the government started to emphasize economic stability, and to depend increasingly on the issuance of government bonds instead of direct borrowing from the Bank of Korea, to finance the budget deficit.

The foreign reserve flow had a significant impact on the growth of the monetary base over this period, even though the magnitude of the impact was much smaller than expected if we consider the high reliance of the Korean economy on the foreign sector. This small magnitude implies that the monetary authority in Korea could sterilize the impact of the foreign reserve flow on the base significantly, though not completely. According to the results obtained, the monetary authorities in Korea offset a large part (around eighty-five percent) of the changes in the foreign reserve flow in the current period by using sterilization policy instruments during the 1970's. These results indicate that Korea's monetary authorities are able to control the monetary base significantly by proper operation procedures. These results also indicate that the requirement for controlling the money growth by the indirect control method, a sufficient controllability of the

monetary base, would be relatively, though not completely, satisfied.

Therefore, within the framework used here, the results furnish evidence that the monetary authorities in Korea would be able to control the quarterly growth of money stock with a reasonable degree of accuracy by using indirect control methods, current operating procedures of monetary policy in Korea, if authorities forecast the money multiplier appropriately. But, it should be emphasized that any conclusion derived from these results should be regarded as tentative, since a relatively short time period has been used to investigate the fundamental questions.

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