

# 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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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," Cowles 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:

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

### 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:

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

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

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 bi-directional 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.)

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

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 (continued)

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

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,  $\Delta\text{RY}(-1)$ , 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-

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 anticycle 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

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.



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.

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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