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A MODEL OF LDC'S FOREIGN RESERVES DEMAND : THE CASE OF KOREA

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ABSTRACT

This paper argues that in addition to conventional determinants of foreign reserve holdings, commodity reserves and creditworthiness must be considered explicitly.

Commodity reserves such as crude oil and other imported raw materials are held in many countries regardless of whether they are developing or developed countries. Commodity reserves are one way in which a country might hold its assets, whereas financial resources are another way. In view of this, the optimum level of foreign reserves and of commodity reserves must be considered jointly.

Creditworthiness should be another important determinant of foreign reserves. This is more so in indebted developing countries. The higher the creditworthiness, the better access to the international credit market, and thus the less need to hold foreign reserves.

Despite the theoretical relationship between the new variables -- commodity reserves and credit worthiness, and the level of foreign reserves, the statistical evidence on the basis of the Korean experience is not strong. This implies that Korea has not been actively taking these new variables into consideration in its management of foreign reserve holdings. On this basis one can say that the monetary anthorities should seriously consider such two important variables in their management of foreign reserves.

I. INTRODUCTION

Most studies of the demand for foreign reserves adopt basically the same methodology that has been used in the studies of the demand for money[1]. The conventional determinants of foreign reserve demand include the scale of the economy, the opportunity cost of holding foreign reserves, the degree of economic openness and the variability of foreign reserves[2].

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1) See the work of Laidler's (1977).

2) Bilson and Frenkel (1979) pointed out the existence of country specific factors in a different context. Within the framework of the adjustment model, they pooled cross-sectional and time series data and showed that the residuals from the estimated demand for foreign reserves contained country-specific as well as time-specific factors. The country-specific factors were believed to be the result of historical, political, and social influences.

Since the pioneering work done by Heller (1966) and Clark (1970), many researchers have examined the demand for international reserves. In early studies, both stock equilibrium and adjustment models have been used to explain changes in foreign reserves. In particular, adjustment models have often been used to examine the speed of adjustment of foreign reserves to its long-run equilibrium value.

Using an adjustment model, Bilson and Frenkel (1979) postulated a reduced form equation that reflected both the central bank's excess demand for foreign reserves and the public's excess demand for money. Kim (1981, 1983) offered a theoretical explanation of this reduced form equation based on explicit optimizing behavior by both the central bank and the public.

Despite the importance of maintaining optimal level of foreign reserves for any individual country, however, relatively little work has been done on foreign reserve demand for a single country. Moreover, most previous studies have focused much attention on the statistical relationships between foreign reserves and the conventional determinants of foreign reserves.

When considering a particular country's foreign reserve demand, other important determinants of reserve demand specific to that country may be evident. In this paper, two new economic variables, commodity reserves and external creditworthiness, are considered as additional determinants of Korea's foreign reserve demand.

Ⅱ. THEORETICAL BACKGROUND

In principle, the inventory stock of commodity reserves, including such key import items as crude oil, food grains, and other important raw materials, will influence the desired level of foreign reserve holdings. Given the overall economy's budget contraint, there would be an inverse relationship between commodity reserves and foreign reserves since both are competing ways to hold assets in the nations' portfolio. Thus, the country's level of commodity reserves needs to be carefully considered when determining the desired level of its foreign reserves.

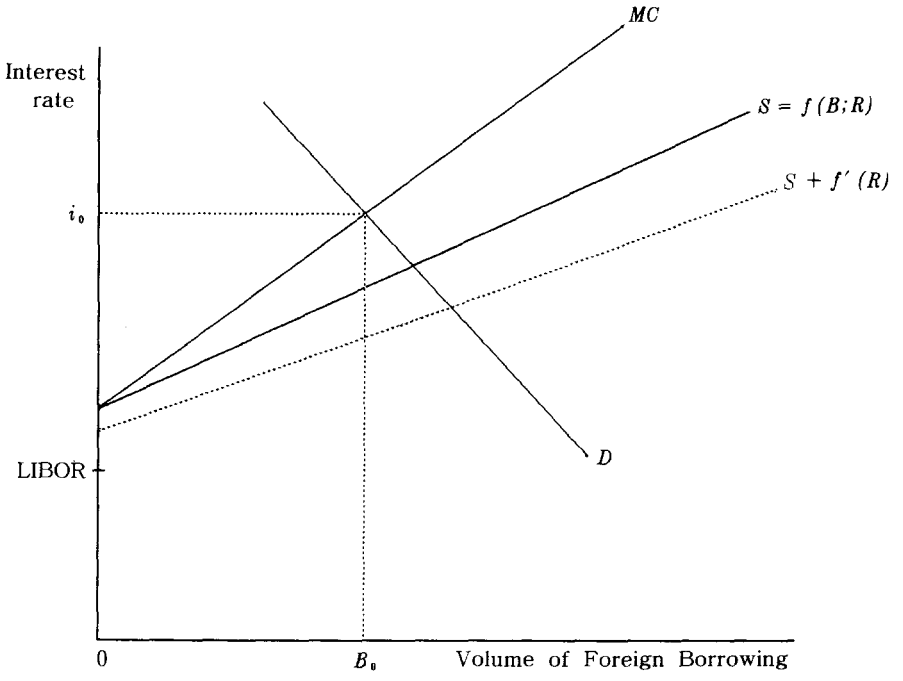
In addition, external creditworthiness would affect the level of the country's foreign reserves. The greater the borrowing country's crediworthiness, the easier access to international credit markets that country will have, and thus, there will be less need to hold foreign reserves.

A simple price-theoretic diagram will demonstrate how creditworthiness affects the level of foreign reserves for an indebted country. As illustrated in Figure 1, one can suppose that a country faces an upward sloping supply schedule, S, and a downward sloping demand schedule, D, in the international credit market.

The supply schedule starts from a point on the vertical axis above LIBOR (London Interbank Offered Rate) based on the fact that developing countries must pay some additional cost in the form of interest spread according to country risk. The marginal cost schedule, MC, lies above the supply schedule since the country as a whole can exercise some monopsony power in world credit markets.

It should be noted that the supply schedule was drawn for any given level of foreign reserves so that the supply function may be expressed as $S=f(B, R)$ in which B and R represent the volume of foreign borrowing and the given level of foreign reserves respectively. The equilibrium interest cost, i_0, and the equilibrium volume of foreign borrowing, OB_0, are determined by the intersection of the marginal cost and demand schedules as depicted in Figure 1.

Now suppose that there is a one dollar increase in foreign reserves. Then the supply and marginal cost schedules will shift out by $f'(R)$, the partial derivative of the supply function with respect to the level of foreign reserves. This shift represents the favorable effect of the one dollar increase in foreign reserves on the cost of borrowing. If foreign reserves are held in the form of interest-bearing foreign assets, then the net opportunity cost of reserve holding becomes the internal rate of return for investment in the domestic country minus the interest paid on foreign assets. Letting the net opportunity cost be denoted by r, optimality condition requires $r=f'(R)$ assuming $f''(R)<0$. Thus new equilibrium is established at the intersection point of the shifted MC schedule (not drawn) and the demand schedule.



[Figure 1] The Determination of Foreign Borrowing

Ⅲ. ESTIMATION

In this section, Korea's demand for foreign reserves is estimated using the two new variables. The reserve demand equation takes the form of a log linear function as follow :

$$(1)\quad lnR = a_0 + a_1 lnP + a_2 lnY + a_3 lnM + a_4 lnB + a_5 lnW + e$$

In this equation, R denotes the level of foreign reserves; P, a measure of the variability of international receipts and payments; Y, a scale variable measuring the size of international transactions; M, the average propensity to import; B, the stock of commodity reserves; W, external crediworthiness; and finally, e, denotes the error term.

Annual data have been used and the sample period stretches from 1963 to 1983[3]. The measure of the dependent variable in the regression equation is foreign reserves divided by the U. S. GNP deflator. The measure of commodity reserves is obtained by taking the inventory stock of imported raw materials in real terms. The magnitude of Korea's imported raw materials is quite substantial as shown in Table 1. The ratio of commodity reserves to foreign reserves in Korea ranges from 10 percent to 250 percent.

Among several measures of external creditworthiness, such as GNP and export growth, price stability, the level of foreign reserves relative to imports, economic management abilities, and debt-servicing capacity, the debt service ratio is adopted as a measure of external crediworthiness in the present estimation. In fact the debt-service ratio, the value of principal and interest divided by current account receipts, is most frequently cited[4]. This is also reported in Table 1.

In Korea, a large fraction of total reserves are held in the form of interest-bearing foreign assets. Due to difficulties in measuring the net opportunity cost of holding foreign reserves on the basis of time series data, it has been dropped in the final estimation stage[5].

The results for the inclusion of the two new variables in the conventional reserve demand equation are reported in three regression equations in Table 2. First of all the conventional variables such as income and import propensity have strong explanatory power as reported in Table 1. It is notable that the income elasticity of reserve demand lies between 0.88 and 1.08 and its t-ratio is sufficiently high. The

3) The author wishes to test his approach for a 20 year period while minimizing the potential effect of different exchange rate regime. Korea adopted the present basket-currency-peg system in February 1980.

4) There are two measures of the debt-service ratio depending on whether the principal of short-term debt is included or not. (Short-term debt matures in less than a year.) In the present estimation the debt-service ratio includes short-term debt. Exclusion of short-term debt, however, did not make a significant difference, however.

5) Edwards (1985) computed the net opportunity cost by taking the cost at which the country borrows from the international financial market and by subtracting from it the LIBOR (London Interbank Offered Rates) and found that the regression coefficient for the net opportunity cost was significantly negative.

coefficient for the average import propensity variable ranges from 0.49 to 0.53, and since its sign is positive, this is consistent with the theoretical consideration of economic openness.

The result for the inclusion of the commodity reserve variable is reported in regression equation (1) of Table 1. The coefficient for this variable is -0.05 with a t-ratio of -0.5. However, when the commodity reserve variable is adopted together with all other variables, its explanatory power increases as shown in equation (3).

A question may arise as to the implicitly assumed exogeneity of the commodity reserve variable. Foreign reserve levels may cause the selection of optimal commodity reserve levels. When the level of foreign reserves increases, it may to some extent reduce the necessity to hoard commodity reserves. In practice, however, the inventory stock of imported raw materials is determined by economic as well as strategic considerations before foreign reserves are determined. Thus the exogeneity of commodity reserves is appropriate to assume.

The external creditworthiness, DSR variable, has the predicted sign. As discussed earlier, the theoretical relationship between external reserves and the debt-service ratio is positive. The higher the debt ratio, the more need there is to hold external reserves, and the coefficient for the DSR variable ranges from 0.05 to 0.17. However, the t-ratio is a bit disappointing as it falls at a low level between 0.59 and 1.34.

Perhaps, the statistical importance of the DSR variable may differ among countries, and so tests such as this should be conducted for other countries before coming to conclusion. Moreover, changes in the debt service ratio may not fully capture changes in Korea's perceived creditworthiness, although DSR is often considered as an important indicator by most international bankers and financial analysts.

Ⅳ. CONCLUSION

This paper investigates the importance of commodity reserves and creditworthiness as additional determinants of a country's demand for foreign reserves. In addition to conventional variables, these new variables are incorporated into the estimation of Korea's demand for external reserves, using annual data from 1963 to 1983.

This study indicates that commodity reserves and external creditworthiness are economically important determinants of foreign reseves and in particular these new variables must be considered more explicitly in managing the desired level of foreign reserves for indebted and developing countries. Estimation results based upon the Korean experience imply that policymakers have not actively taken into consideration external creditworthiness and commodity reserves in choosing the optimal foreign reserve levels.

While further tests of the approach taken in this study can be made for many other countries, one should note that there may be some adjustment factors such as exchange rate regime and persistent trade imbalances. Theoretically, more flexible exchange rates would require less foreign reserves and persistent trade surplus would

require less foreign reserves than persistent trade deficit would. These issues, however, have not been explored in the present study because of the deficiency of the sample data. Korea's foreign exchange rates have been changing on a daily basis since early 1980 and Korea's trade account has been in surplus since 1986.

[Table 1] Major Statistics

(unit : million U. S. dollars)

	(A) Foreign Reserves	(B) current GNP	(C) Import Value	(D) Commodity Reserves	(E) DSR[1)]	D/A
1963	134. 6	2769	497. 0	220. 6	0. 9	1. 64
1964	138. 4	2930	364. 9	296. 1	2. 6	2. 14
1965	151. 1	3063	415. 9	303. 1	5. 0	2. 0
1966	253. 7	3741	679. 9	355. 4	3. 2	1. 40
1967	456. 5	4356	908. 9	377. 8	5. 4	0. 83
1968	398. 6	5327	1322. 0	427. 7	5. 4	1. 07
1969	613. 3	6753	1650. 0	643. 1	8. 6	1. 05
1970	689. 6	7986	1804. 2	851. 8	18. 5	1. 24
1971	571. 0	9367	2178. 2	1177. 9	21. 7	2. 06
1972	739. 7	10573	2250. 4	1409. 0	18. 7	1. 91
1973	1094. 4	13504	3837. 3	1719. 7	14. 8	1. 57
1974	1055. 7	18549	6451. 9	2703. 3	13. 1	2. 56
1975	1550. 2	20852	6674. 4	3647. 0	14. 4	2. 35
1976	2960. 6	28680	3405. 1	4088. 4	12. 8	1. 38
1977	4306. 4	37429	10523. 1	4494. 2	11. 9	1. 04
1978	4937. 1	51960	14491. 4	4682. 9	13. 9	0. 95
1979	5708. 1	62374	19100. 0	6541. 8	16. 3	1. 15
1980	6571. 4	61203	21598. 1	6172. 4	18. 7	0. 94
1981	6891. 0	67191	24299. 1	6365. 0	20. 7	0. 92
1982	6983. 7	70979	23473. 6	4100. 4	20. 9	0. 59
1983	6909. 7	75319	24903. 0	1045. 4	19. 3	0. 15

Notes : DSR denotes the debt service ratio which takes the principal of short-term debt into account.

Sources : *National Income Accounts*, 1984, The Bank of Korea.
Various issues of *Economic Statistics Yearbook*, The Bank of Korea.
Various issues of *Fiscal and Monetary Statistics*, The Ministry of Finance, Korea.

〔Table 2〕 Estimation Results for Korea's Demand Function for Foreign Reserves (Cochrane-Orcutt Method)

Foreign Reserves *(lnr)*	Constant	Real Income *(lny)*	Average Import Propensity *(lnAPI)*	Debt Service Ratio *(lnDSR)*	Commodity Reserves *(lnINV)*	R^2	s. e.	Rho	*D. W.*
(1)	-2. 21	1. 08	0. 53		-0. 05	0. 894	0. 215	0. 213	1. 69
	(-1. 21)	(5. 83)	(1. 82)		(-0. 5)				
(2)	-0. 94	0. 88	0. 49	0. 17		0. 891	0. 206	0. 264	1. 65
	(-0. 49)	(0. 97)	(1. 75)	(1. 34)					
(3)	-1. 76	1. 05	0. 53	0. 05	-0. 09	0. 886	0. 211	0. 261	1. 66
	(-1. 03)	(6. 23)	(1. 94)	(0. 59)	(-0. 96)				

Notes : 1) The empirical results reported here are based on annual data for the period between 1963 and 1983.

2) Notations above *r*, *y*, *API*, *DSR*, and *INV* represent real total reserves, real income, average propensity to import, debt-service ratio and inventory stock of imported raw materials in real terms respectively.

3) The t-ratios are reported in parentheses below the estimated coefficients and s. e. represents the standard error of the regression. R^2 is the corrected coefficient of the determination, and *D. W.* denotes the value of the Durbin-Watson statistic.

4) The critical t-value for each variable at the 95 percent significance level is between 1. 328 and 1. 330.

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