

Assessment of External Debt Servicing Capacity: An Alternative Methodology*

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I. Introduction

Following the seminal work of Avromovic and his associates on economic growth and external debt (1964), a number of various methods of assessing debt service capacity have been suggested. Notable examples are such as discriminant and logit analyses (Frank and Cline, 1971; Feder and Just, 1977), ratio analysis (Sofia, 1981), checklist or selected variable method (Thompson, 1981), and market spread rate analysis (Haegele, 1981; Institutional Investor). Also, the recent surveys by the Exim Bank (1976), the Association of Reserve City Bankers (1977), and the Robert Morris Associates (1980) confirm that U.S. commercial banks do use a variety of evaluation methods ranging from informal qualitative methods to formalized qualitative methods, and from checklist methods to econometric methods, each method using 20 to 30 different economic and political variables.

The shortcomings of these approaches are the fact that they are less coherent in approach and they do not take full advantage of standard methods widely used in corporate financial statement analysis. This study makes a direct use of such methods to analyze

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economic spread sheets. And the procedure suggested here is coherent in a sense that it starts out with simple ratio analysis and proceeds step by step toward a full-scale economic analysis. This approach would particularly be useful for practitioners in financial management.

The paper consists of four parts. The first part applies the static Du Pont system of financial ratio analysis to trace systematically down problem areas of debt servicing capacity, starting with the ratio of debt service to GNP. The second part deals with the paired ratio analysis which employs two ratios simultaneously to produce a classification boundary between good and problematic borrower countries.

In the third part, we use the economic block decomposition analysis, as applied in financial statement analysis by Theil (1972) and Lev (1974), to measure the variation of major components of each economic spread sheet (balance of payments sheet, balance sheet of monetary authorities, government budget sheet, and flow-of-funds sheet).

In the final part, concluding remarks are given, suggesting a full-scale analysis of each item in each spread sheet.

II. Grouping of Countries

For comparison purposes, chosen are seven countries (Brazil, Indonesia, Korea, Malaysia, Mexico, Philippines, and Turkey) which are (a) active in the international credit markets, (b) newly industrializing rapidly¹, (c) within the middle income country bracket as defined by The World Bank, and (d) of the relatively large population size (30 million or more except Malaysia). Table 1 shows the profile of these seven countries. For our discussion, Korea is singled out for illustrative purposes. The static ratio analysis is then followed by a dynamic analysis and by a statistical analysis.

¹ The NICs, as defined by the OECD, include Brazil and Mexico in Latin America; Greece, Portugal, Spain and Yugoslavia in Southern Europe; and the Republic of China, Hong Kong, Republic of Korea and Singapore in Asia.

Table 1
PROFILE OF SEVEN COUNTRIES (1981)

Country	Population (in mill.)	Per Capita Income (in US \$)	Per Capita GNP Growth Rate (1960-81) (percent)	1981 Debt Outstand- ing (Public/ Publicly Guaranteed) (in bill. US \$)
Brazil	120.5	2220	5.1	44.0 (63.8)*
Indonesia	149.5	530	4.1	15.5 (—)
Korea	38.9	1700	6.9	20.0 (20.7)
Malaysia	14.2	1910	3.1	4.6 (—)
Mexico	71.2	2250	3.8	42.6 (—)
Philippines	49.6	790	2.8	7.4 (10.1)
Turkey	45.5	1540	3.5	13.8 (14.2)

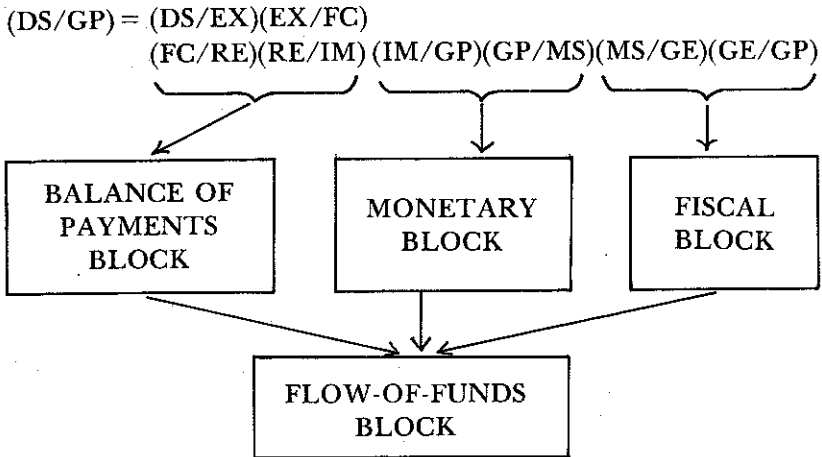
* The figures in parentheses represent total debt outstanding including private non-guaranteed loans.

Sources: The World Bank, *World Development Report, 1983: World Debt Table 1982-83 Edition*.

From a methodological point of view, grouping of countries is essentially a problem of pattern recognition. A useful approach would be application of cluster analysis, which, however, is left for a future research topic.

III. Individual Ratio Analysis

Following the Du Pont method of financial ratio analysis, we decompose the ratio of debt service to GNP into the eight ratios which will first provide the basis of the rule of thumb analysis and will serve as linkage points for the four economic blocks. The economic blocks, represented by their respective economic spread sheets, may in turn lead to the full-scale analysis.



where variables are

- DS = debt service
- GP = gross national product
- EX = exports of goods and services
- IM = imports of goods and services
- FC = gross foreign capital inflows
- RE = official reserves
- MS = money supply
- GE = government expenditures

and ratios are

- DS/GP = ratio of debt service to GNP
- DS/EX = debt service ratio
- EX/FC = ratio of exports to foreign capital inflows
(composition of sources of foreign exchange)
- FC/RE = ratio of foreign capital inflows to official reserves
(contribution of foreign capital to official reserves)
- RE/IM = import cover
- IM/GP = average propensity to import
- GP/MS = income velocity (also indirect measure of financial deepening)
- MS/GE = ratio of money supply to government expenditures
- GE/GP = ratio of government expenditures to GNP

On the basis of the above analytic scheme, Tables 2 and 3 are constructed. Table 2 shows the eleven-year averages (1971-81), whereas Table 3 represents the 1981 characteristics. An individual country ratio may be compared with its group average (or regional or worldwide average). The underlying rationale for comparing an individual ratio with an average, particularly a well defined group average, is: First, it assumes that the law of large numbers works. Second, it also assumes that each country is doing its best under the given circumstances. Therefore, the average ratio is the representation of the best. Any deviation from the average thus requires further investigation.

For individual ratio analysis, we may approach in three different ways: (a) static analysis, (b) time profile analysis, and (c) statistical analysis.

Static Analysis

For static analysis, we may begin with the ratio DS/GP of a particular country in question. In general, a lower DS/GP may be regarded desirable. During the period from 1976 to 1981, the DS/GP of Korea, along with Mexico, was relatively high as compared with the world average, requiring further tracing and pinpointing the problem areas.

For Korea, the ability to earn foreign exchange to service external debt DS/EX and the composition of sources of foreign exchange EX/FC seem satisfactory. On the other hand, the next two ratios, the ratio of foreign capital inflow to reserves and import cover, FC/RE and RE/IM, would require a greater attention. In particular, a steady deterioration of the import cover since 1979 presents a warning signal. The average propensity to import IM/GP is an indication of the openness of the economy. The success in rapid economic growth through exports has steadily widened the foreign sector, accounting nearly 40 percent of the economy and in turn has exposed the economy highly susceptible to external economic conditions, as experienced in 1980 with a negative growth rate.

The income velocity of money GP/MS and the relative size of money supply to government expenditures MS/GE may require analysis of cyclical variations more than the comparison of particular levels. Korea has had relatively low variations (in terms of

standard deviation) over the eleven-year period. But we may note a striking similarity in the values of the above ratios of these seven countries. The GP/MS provides a linkage to the monetary sector and the MS/GE gives a ground for monetary and fiscal interactions. The last ratio, GE/GP gives an indication of the role of government in the economy. This ratio should be interpreted in a longer term perspective.

Table 2

1971-1981 AVERAGE RATIOS

	DS/GP	DS/EX	EX/FC	FC/RE	RE/İM	İM/GP	GP/MS	MS/GE	GE/GP
Brazil	.018	.223	2.53	.78	.397	.123	7.41	1.445	.107
Indonesia	.023	.085	5.55	1.19	.214	.260	9.37	.543	.202
Korea	.040	.129	4.44	1.63	.144	.390	8.52	.716	.169
Malaysia	.021	.040	16.77	.20	.443	.525	5.04	.677	.300
Mexico	.041	.329	2.19	2.37	.184	.141	9.11	.817	.160
Philippines	.018	.087	6.73	.42	.365	.253	10.67	.650	.154
Turkey	.011	.187	5.75	.52	.439	.132	4.84	.945	.227
Group Av.	.025	.154	6.28	1.02	.313	.261	7.85	.828	.188
Asian Av.	.021	.063	8.08	.40	.295	.363	7.72	.719	.227
Latin Av.	.025	.179	3.66	.60	.391	.166	7.92	.760	.203
World Av.	.022	.111	4.86	.50	.369	.217	6.35	.823	.258

Sources: The World Bank. *World Debt Table*, 1981 and 1982-83 editions.

IMF. *International Financial Statistics*, various issues.

Notes: The Asian, Latin American, and world average ratios of GP/MS, MS/GE and GE/GP are computed with the data covering the period from 1976 to 1981. To compute regional average, countries are grouped in accordance with the regional classification adopted in the *World Debt Table*. However, not all the countries in each region are covered due to lack of data. A list of countries included in the computation may be obtained from the author upon request.

Table 3
1981 INDIVIDUAL RATIOS

	DS/GP	DS/EX	EX/FC	FC/RE	RE/IM	IM/GP	GP/MS	MS/GE	GE/GP
Brazil	.031	.319	2.96	1.22	.19	.14	18.65	.63	.08
Indonesia	.024	.083	10.08	.38	.25	.30	8.10	.48	.26
Korea	.057	.130	4.53	2.17	.08	.51	10.84	.49	.19
Malaysia	0.17	.081	6.85	.37	.33	.66	4.93	.45	.45
Mexico	.037	.283	2.26	2.68	.12	.19	8.90	—	—
Philippines	.022	.103	5.57	.53	.26	.28	13.33	.60	.12
Turkey	.020	.133	4.82	.65	.25	.19	2.72	—	—
Group Av.	.030	.154	5.30	1.14	.21	.32	9.64	.53	.22

Sources: See Table 2.

Time Profile Analysis

As pointed out earlier, a lower DS/GP may be regarded desirable from a static point of view. However, in the course of economic development, a developing country may go through a substantially different profile over the period. Following Solomon (1977), we shall specify the external debt outstanding at time T , $D(T)$, as a cumulative function of gap at each period t between domestic investment $I(t)$ and domestic saving $S(t)$ as below:

$$I(t) = \left(\frac{\Delta K}{\Delta Y}\right) \left(\frac{\Delta Y}{Y}\right) Y_t = kg Y_o e^{gt}$$

$$S(t) = \left(\frac{S}{Y}\right) Y_t = s Y_o e^{gt}$$

$$\begin{aligned} D(T) &= \int_0^T (I(t) - S(t))e^{i(T-t)} dt \\ &= \int_0^T (kgY_o e^{gt} - sY_o e^{gt})e^{i(T-t)} dt \\ &= \frac{(kg - s)}{(g - i)} Y_o (e^{gT} - e^{iT}) \end{aligned}$$

where $k = \Delta K / \Delta Y =$ incremental capital-output ratio
 $g = \Delta Y / Y =$ GNP growth rate

$s = S/Y =$ average propensity to save
 $Y_0 =$ GNP in period 0.

Since the debt service is the average principal repayment $D(T)/N$ plus interest payment $iD(T)$, i.e.,

$$(1/N + i)D(T)$$

the ratio of debt service to GNP can be expressed as:

$$\frac{(1/N + i) D(t)}{Y_0 e^{gT}} = \left(\frac{1}{N} + 1 \right) \left(\frac{kg - S}{g - i} \right) \left(\frac{kg - s}{g - i} \right) (1 - e^{(i-g)T})$$

The time profile of debt service will then be determined by changes in the term $(1 - e^{(i-g)T})$ with debt service leveling off at $(1/N + i)(kg - s)/(g - i)$, provided that $g < i$. On the other hand, the debt service amount would become explosive if $g > i$. It should be noted that, for example, a three percent difference between g and i would enable the debt service to converge to the maximum level in about 100 years and would reach a half way of the maximum level by the 23rd year or so.

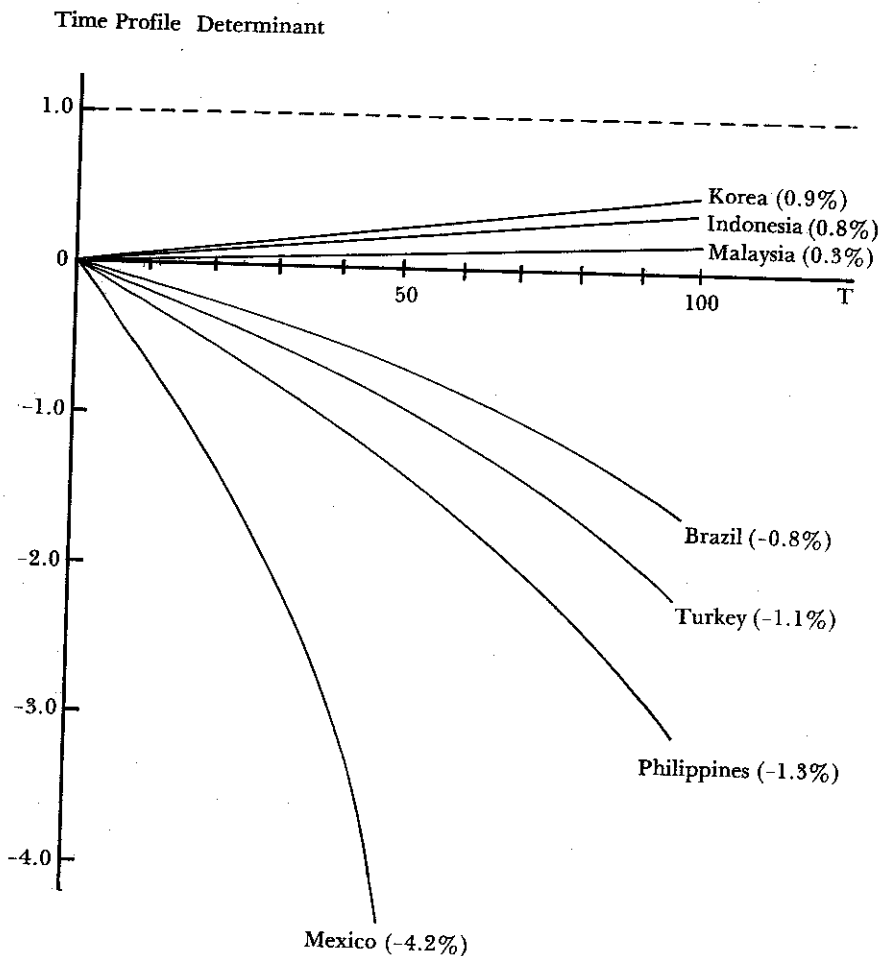
Based on the data for the period (1970-80), the time profile for the ratio DS/GP of each of the seven countries is constructed in Figure 1. Three countries, Korea, Indonesia, and Malaysia would experience their debt service to converge to a scale of $(1/N + i)((kg - s)/(g - i))$, whereas the remaining four countries, Brazil, Turkey, Philippines, and Mexico would face an explosive debt service without an upper limit. The fact that the rate of growth is less than the interest rate implies mismanagement of investment. In a longer run this appears to be a crucial factor determining the debt servicing capacity of a country.

Statistical Analysis

To determine statistical significance of the eight chosen ratios as components of the DS/GP, a linearized model with log transformation is used as below:

Figure 1

TIME PROFILE OF RATIO OF DEPT SERVICE TO GNP



Note: Figures in parentheses represent the difference between the GNP growth rate and the interest rate, $(g-i)$.

Time profile determinant: $(1-e^{(i-g)T})$

g : average of 1970-1980

i : average of 1971-1980

Table 4
Regression Analysis (1971-1981)

	Const.	DS/EX	EX/FC	FC/RE	RE/IM	IM/GP	GP/MS	MS/GE	GE/GP
Brazil R ² =0.999 F=1434.66 SE=0.016	0.592 (3.60)	1.084 (34.43)	1.043 (12.07)	0.960 (7.97)	1.047 (10.62)	2.122 (22.63)			0.097 (3.25)
Indonesia R ² =0.884 F=39.11 SE=0.186	0.364 (0.73)	0.782 (5.74)							1.470 (7.40)
Korea R ² =0.876 F=18.70 SE=0.071	-0.576 (-1.66)	0.551 (3.63)	-0.146 (-2.00)		0.227 (4.09)	1.496 (8.06)			
Malaysia R ² =0.986 F=232.43 SE=0.064	0.117 (7.05)	1.161 (23.25)	0.095 (2.53)			0.759 (5.81)			
Mexico R ² =0.981 F=172.92 SE=0.071	-0.580 (-2.31)	1.209 (15.33)	0.172 (2.55)			0.8011 (5.97)			
Philippines R ² =0.630 F=18.03 SE=0.174	-2.068 (-4.40)	0.813 (4.246)							
Turkey R ² =0.797 F=14.09 SE=0.163	-5.244 (-5.01)	0.551 (2.47)			2.631 (0.27)		1.384 (3.31)		
Group with significant variables only R ² =0.922 F=301.49 SE=0.162	-0.280 (2.28)	0.981 (21.71)	0.097 (2.37)		2.631	1.082 (25.03)	1.384		
Group with all variables R ² =0.923 F=114.24 SE=0.161	-0.264 (-1.05)	0.999 (19.84)	0.107 (1.75)	-0.007 (-0.16)	0.044 (1.47)	1.002 (15.17)	-0.096 (0.51)	-0.205 (-1.17)	-0.040 (-0.22)

Sources: See Table 2.

Note: Figures in parentheses are t-ratios.

$$\begin{aligned} \ln(\text{DS/GP}) = & a + b_1 \ln(\text{DS/EX}) + b_2 \ln(\text{EX/FC}) + b_3 \ln(\text{FC/RE}) \\ & + b_4 \ln(\text{RE/IM}) + b_5 \ln(\text{IM/GP}) + b_6 \ln(\text{GP/MS}) \\ & + b_7 \ln(\text{MS/GE}) + b_8 \ln(\text{GE/GP}) + \epsilon \end{aligned}$$

The group estimates are based on the cross sectional time series data. The results in Table 4 indicate that the most significant components are DS/EX (experienced by 7 out of 7 countries),

EX/FC (4 out of 7), and IM/GP (4 out of 7), which are all elements of the balance of payments block. In every case, the ratio MS/GE is found insignificant. This leads us to a tentative conclusion that we should focus our attention more on the balance of payments block rather than others.

On inter-country comparison, a striking similarity in the structure is found between Korea and Brazil and between Malaysia and Mexico.

IV. Paired Ratio Analysis

Once individual ratio analysis is completed, we may proceed to analyze a pair of two ratios simultaneously to extract further information. It is suggested here that the individual ratios be paired according to their explanatory power is short-term versus long-term as follows:

(a) RE/IM and DS/EX

These two ratios are essentially to measure the capacity of a country to meet its international liquidity need. Figure 2 shows the relationship between these two ratios of seven countries for the last 11 years (1971-81). Using the group averages, we may form four zones:

Zone I: Flexible and comfortable

This zone represents the most desirable situation. It is flexible in the sense that a higher RE/IM provides flexibility to the policy-makers in implementing economic adjustment. It is also comfortable in the sense that a lower DS/EX is easier to manage.

Zone II: Inflexible but comfortable

If a country is in this zone, it faces inflexibility in making any prolonged adjustment in the economy and it cannot permit too large fluctuations in either sources of international reserves or their uses. Nonetheless, due to the low debt ratio, the debt service is easier to manage without relying on foreign sources of capital.

Zone III: Flexible but uncomfortable

In this case the situation is exactly opposite to Zone II. If a choice is to be made between Zone II and III, the former is preferable because the flexibility zone may be increased by international borrowing but it is more difficult to attempt to reach Zone II simply by reducing official reserves.

Zone IV: Inflexible and uncomfortable

This zone represents the least desirable situation. It suggests the need of examining the entire foreign sector of the economy.

Korea falls in Zone II. But note that the difference between the group average and the worldwide average. The group averages of these seven countries are characterized by the lower RE/IM and the higher DS/EX relative to the worldwide averages. It would be interesting to investigate the direction of movement of the pair of these ratios in relation to economic growth. As shown in Figure 2, we may hypothesize that the pair of these world average ratios are likely to move toward the seven-country group averages, as more of less developed countries in the world go through a similar growth experience which these seven countries have had. Also note the difference between the Asian countries averages and the Latin American countries averages. Is this to suggest a philosophical difference in economic management?

(b) *EX/FC and FC/RE*

This pair is useful to measure the cyclical variation in sources of foreign exchange. Figure 3 is devised in a similar way as Figure 2. And a similar interpretation may be given. Korea falls in Zone IV which implies the inflexible and uncomfortable situation, implying some underlying weakness of the economy.

(c) *GP/MS and MS/GE*

This pair is also to represent the cyclical index, which may require the variance analysis.

(d) *IM/GP and GE/GP*

This pair is to represent the long-term trend. An erratic variation would cause a greater concern.

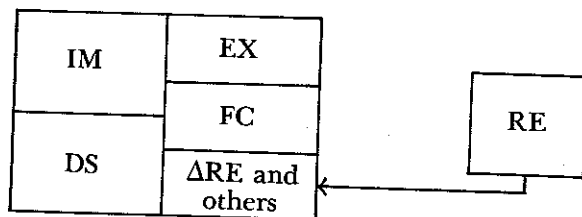
V. Decomposition Analysis

Statistical decomposition analysis is generally designed for the study of variation of components of a whole such as a balance sheet or an income statement. The decomposition measure for year s to t , $K(s, t)$ may be defined as:

$$K(s, t) = \sum_j p(t_j) \ln p(t_j)/p(s_j)$$

where $p(t_j)$ is the percentage of j relative the whole in year t and $p(s_j)$ is that in year s .

Thus, each economic block may be treated as a whole. For instance, the balance of payments block may be subdivided into the following component items.

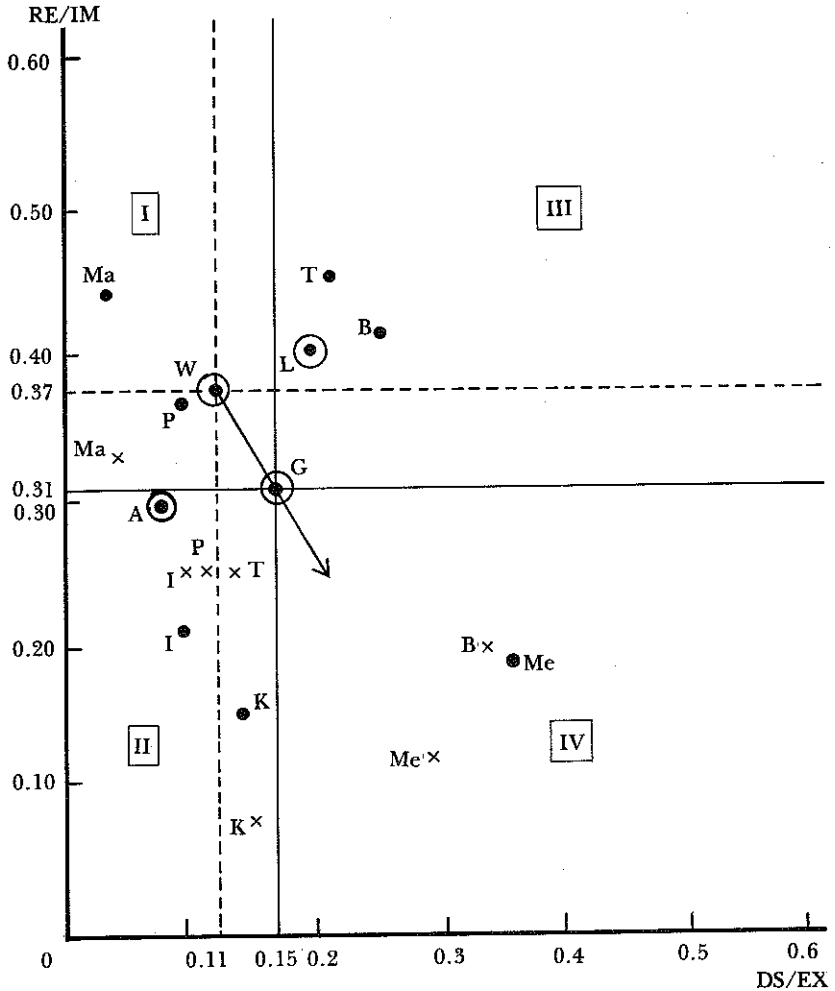


Dividing each of the five categories by twice the balance of payments total yields a set of five nonnegative fractions which sum to 1. These fractions are denoted by $p(j)$.

Table 5 shows the three-year trend (1978-81) of component variations of the balance of payments block for those seven countries. Korea maintained relatively small nits, implying that component variation of the balance of payments block was relatively stable. From the methodological point of view, decomposition measures belong to the family of statistical measures as do the variance and the standard deviation. Decomposition measures indicate deviation from proportional development of component items, while the variance measures the extent of deviation from the mean (Lev, 1974). Decomposition measures do not require the normality assumption.

Figure 2

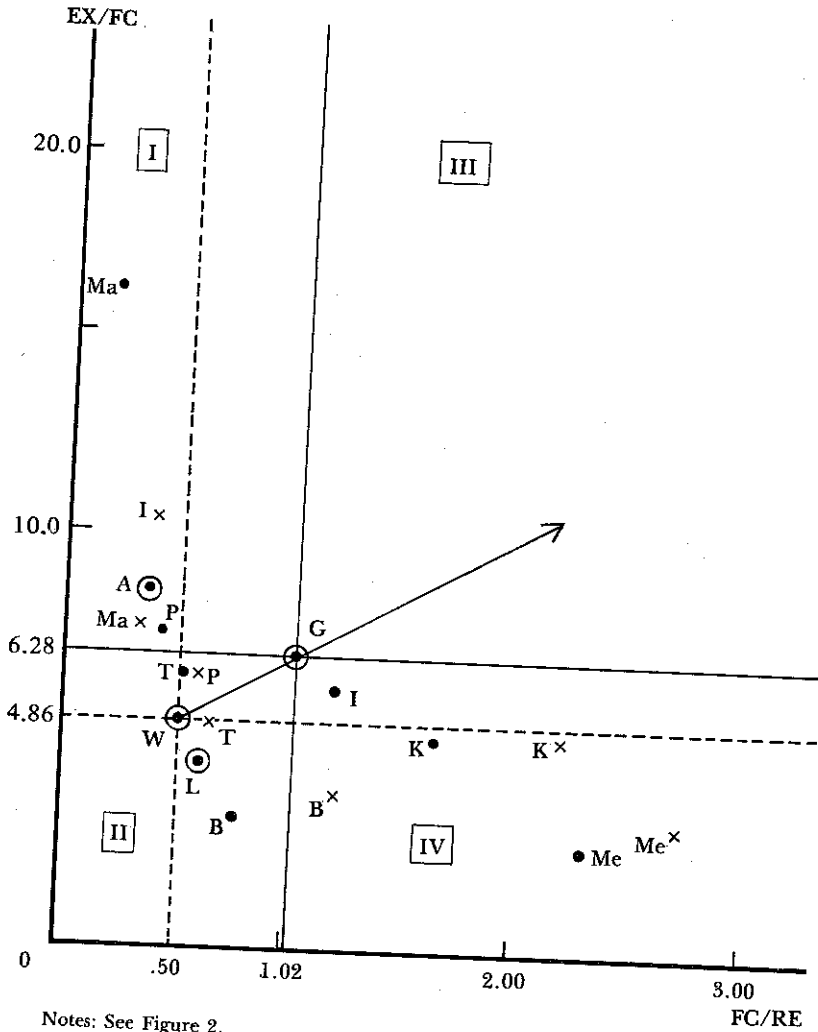
CLASSIFICATION OF COUNTRIES BY PAIRED RATIOS
(RE/IM AND DS/EX)



- Notes: (a) For individual countries
 • average (1971-1981)
 x yearly data (1981)
 (b) G: group average; W: worldwide average
 A: Asian countries average; L: Latin American countries average

Figure 3

CLASSIFICATION OF COUNTRIES BY PAIRED RATIOS
(EX/FC AND FC/RE)



Notes: See Figure 2.

Table 5

DECOMPOSITION MEASURES OF
THE BALANCE OF PAYMENTS BLOCK

	1978/79	1979/80	1980/81	3-Year Av.
Brazil	.047	.019	.006	.024
Indonesia	.218	.043	.041	.100
Korea	.030	.022	.017	.023
Malaysia	.032	.040	.090	.054
Mexico	.032	.035	.005	.024
Philippines	.001	.014	.002	.006
Turkey	.112	.055	.021	.063
Group Av.	.067	.033	.026	.042

Sources: See Table 2.

VI. Concluding Remarks

Through the individual ratio analysis combined with the paired ratio analysis and decomposition measures, it appears that Korea's debt servicing capacity is reasonably satisfactory but with some caution. Particularly, the low import cover which is statistically significant as a component of the DS/GP requires a further attention. A sign of improvement appeared in 1982. The current account deficit was reduced from \$4 billion in 1981 to \$2 billion in 1982 mainly by restraining imports.

A striking result is observed in the time profile analysis where three countries, Korea, Indonesia, and Malaysia would experience their debt service to converse, whereas the remaining four countries, Brazil, Turkey, Philippines, and Mexico, would face an explosive increase in their debt service.

From here a more full-scale economic analysis may be pursued by constructing a statistical model for each item in each economic block. Because of the data limitations and the importance of

isolated events in the underlying series, econometric forecasts may not be sufficiently accurate for credit decision makers and must therefore be supplemented by experience and judgement to arrive at realistic values (IMF Institute, 1981). However, such forecasts may be constructively used as a control tool in order to pinpoint the problem areas. Meanwhile, the methods suggested in this paper will serve as a convenient tool to provide a first-step diagnosis.

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