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Indicator Systems for the Assessment of the External Debt Situation of Developing Countries

by Rainer Erbe, Susanne Schattner, Hamburg*

The foreign indebtedness of the Third World has been increasing rapidly over the past ten years. The volume of private and public borrowings expanded between the end of 1970 and the end of 1979 from \$ 64 bn to \$ 376 bn¹. This development has quickened the interest in methods for an assessment of the external debt situation of developing countries. Interested parties – commercial banks, international organizations, etc., and the borrowers themselves – are looking for criteria by reference to which they can monitor foreign indebtedness and ascertain in good time whether and when the foreign debt of a country is in danger of reaching “critical” dimensions. What view should be taken of the various criteria?

In connection with the assessment of the external debt situation of developing countries great attention is still being paid to “classical” single indicators which may be compared with certain traditional rules for the financing of business enterprises and are, like these, without a real rationale. One of these is the debt service ratio (interest and amortization in per cent of export earnings) for which “critical” values are fixed more or less arbitrarily. Yardsticks of this kind are however occasioning wide-spread misgivings; their limited evidential value – not to say inaptness – has been exposed in the literature² and is not really questioned in practice. A number of attempts have therefore been made in recent times to evolve through empirical studies indicator systems which get away from the practice of looking at individual criteria in isolation.

Indicator systems of this kind are designed mainly as “early warning systems”. The aim is to identify and combine critical data combinations relating to the selected basket of indicators so as to recognize crises of indebtedness early enough to leave time for action

to forestall critical situations. The identification of critical data combinations presupposes however the possibility of ascertaining stable functional relationships between the probability of a default and the level of certain sectoral or overall economic aggregates.

Selection of Indicators

The attempts to design indicator systems are based on a number of predominantly theoretically-oriented studies trying to analyse and systematize types and causes of debt problems and to affiliate, as far as possible, characteristic statistical time series with particular sets of problems³. In this way it is hoped to create the prerequisites for the description and interpretation of debt problems. No attempt was however made to check the actual evidential value of the potential indicators or the determination of critical

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¹ Cf. World Bank, Annual Report 1980.

² Dragoslav Avramovic et al.: Economic Growth and External Debt, Baltimore 1964; OECD: Debt Problems of Developing Countries, Paris 1974.

³ Cf., e. g., OECD, *ibid.*, and Avramovic, *ibid.*

levels. The question of the availability and quality of statistical base data accordingly played a secondary role.

The empirical studies for the design of early warning systems take off from this point. Depending on what the individual author considers plausible and what statistical data are available, a larger or smaller number of potential indicators are examined to establish their relevance.

Among the studies pointing in this direction are for instance those by Frank and Cline (1971)⁴, Dhonte (1975)⁵ and Feder and Just (1977)⁶. The aim is to identify especially relevant indicator combinations and/or eliminate factors of no demonstrable significance by statistical-econometric methods (multivariate procedures). These studies produce index functions in which the assumedly significant factors appear as independent variables. Critical values or critical areas are determined for these functions.

While indicator trend projections are indispensable when these indicator systems are used for prognosticating debt crises, Petersen in the design of his early warning system⁷ tries to avoid this detour. His aim is to forecast future debt problems by a direct route, i. e. by drawing on already available statistical data. He must therefore work with relatively long time-lags for his indicators as any prognostication of debt crises has to be based on data some of which relate to times one or several years before the date of the forecast.

Common to all empirical studies which are directly or indirectly aimed at designing indicator systems is, in principle, the approach of trying to discover indicators which have revealed significant differences between countries with and without debt problems in the past. In order to illustrate this approach, Petersen's system is dealt with in somewhat greater detail here and then briefly contrasted with the findings of Feder/Just and Frank/Cline.

Petersen's early warning system has been selected because it is derived from the most comprehensive

"indicator catalogue". Besides, Petersen's method alone is designed for immediate application. Moreover, it seems to meet with interest in banking practice, not least probably because of its relatively simple design. It does without sophisticated statistical methods but produces apparently nevertheless relatively good prognostic results.

Petersen's Early Warning System

Petersen originally included 41 different potential indicators in his inquiry – 35 indicators which the OECD had suggested to outline various sets of problems and six others which have been discussed by Dhonte in his study. Lack of statistical data ruled out 16 of the OECD indicators. For the 25 remaining indicators Petersen was able to assemble fairly complete time-series from the beginning of the sixties until 1973. He did this for five countries which had to submit to multilateral debt rearrangements on one or more occasions in the period under review and for a comparable group of 20 developing countries whose debts were not rescheduled. Petersen next examined the mean indicators of the two groups for any significant deviations at dates three to five years prior to the debt rearrangements. The choice of a three-to-five-year antecedent period was purely pragmatic. It represents the minimum time-lag needed to enable an early warning system to be designed. The comparison of the series showed that none of the indicators regularly revealed higher or lower figures for the countries with rescheduled debts than the average of the control group – a result which is not particularly surprising. Petersen however noted a group of 12 indicators which signified differences at least relatively frequently.

The further elaboration of Petersen's early warning system was by and large intuitive. He varied the indicator combinations and thresholds and checked their relevance by a process of trial and error, simply comparing the data obtained in *ex-post* forecasts. His criterion was correct prognostication of the maximum number of debt rearrangements actually carried out in the countries under review and a minimum of debt rearrangements not subsequently effected. The outcome was an indicator system comprising the following seven indicators and ten critical values (two critical thresholds were fixed for each of three indicators).

The assessment is based on moving three-year averages. The indebtedness of a country is judged to be critical if at least four of the indicators rise above or fall below the thresholds.

⁴ C. R. Frank, W. R. Cline: Measurement of Debt Servicing Capacity: An Application of Discriminant Analysis, in: Journal of International Economics, No. 1, 1971, p. 327 ff.

⁵ P. D. Dhonte: Describing External Debt Situations: A Roll-Over-Approach, in: IMF Papers, Vol. XXII, No. 1, 1975, p. 519 ff.

⁶ G. Feder, R. E. Just: A Study of Debt Servicing Capacity Applying Logit Analysis, in: Journal of Development Economics, No. 4, 1977, p. 25 ff.

⁷ Cf. Hans J. Petersen: Debt Crisis of Developing Countries: A Pragmatic Approach to an Early Warning System, in: Konjunkturpolitik, 23rd year, 1977, No. 2, p. 94 ff.

Table 1
The Indicator System of Petersen

Indicator	1st Threshold	2nd Threshold
1. Debt/exports ratio	> 120 %	160 %
2. Gross foreign investment income/exports ratio	> 10 %	—
3. Current account balance/imports ratio	> 20%	—
4. Reserves/imports ratio	< 2½ months	—
5. Change in reserves	< 0 %	-20 %
6. Inflation rate	> 12%	—
7. Growth of real GNP	< 3%	0 %

Petersen next calculated indicator series – as far as was possible – from 1960 until 1975 for 40 countries. *Ex-post* predictions by means of his system enabled him to identify correctly 21 of 28 multilateral debt reschedulings (in 11 countries) during the 1964-76 period. In three cases an inadequate data basis made it impossible to apply the system. The other four reschedulings – which incidentally were for three mineral-rich countries (Chile, Peru, Zaire) – were not preindicated.

The present authors have up-dated the time-series as calculated by Petersen for 36 of his 40 countries (see Table 2) and attempted to check the prognostic value of the model with reference to debt rearrangements since the closing date of Petersen's work. The ten multilateral debt settlements in this group of countries from 1976 to mid-1980 of which we have knowledge were all preindicated in good time by the Petersen system. For the 1976-79 period the Petersen system indicated a total of 53 critical situations in 26 countries (compared with altogether 144 observations in 36 countries during the four years). In no more than five countries however were debts actually rescheduled. The Petersen system thus often predicts crises which later do not give rise to multilateral debt rearrangements.

Findings of Frank/Cline

The approach of Frank and Cline does not differ in its essentials from that of Petersen. They also distinguish two groups of countries, and the dividing line for them is likewise whether debts were rescheduled multilaterally or not. The study of Frank and Cline takes in 26 countries including eight countries with altogether 13 defaults. They deal with the period from 1960 to 1968. Scarcity of data limited their observations however to no more than 145. Eight indicators were

Table 2
Debt Crises Prognosticated by the Petersen System for 1976-80

Country ²	1976	1977	1978	1979	1980
Bolivia	x				
Brazil				x	x
Central African Republic					x
Chile	x	x	x	x	x
Dominican Republic		x			
Egypt				x	x
Ghana			x	x	x
Greece			x	x	
Haiti			x		
India	x ¹	x ¹			
Indonesia	x				
Israel	x	x	x	x	x
Jamaica	x	x	x	x	x ¹
Kenya			x		
Madagascar				x	
Mali	x	x	x	x	x
Mexico		x	x	x	x
Pakistan		x	x	x	x
Peru			x ¹	x	x
Sierra Leone			x ¹	x	x ¹
Somalia			x	x	x
Sudan			x	x ¹	x
Tanzania			x	x	x
Turkey	x	x	x ¹	x ¹	x ¹
Yemen, People's Republic			x		
Zambia	x		x	x	x

¹ Years in which multilateral debt rearrangements took place. ² The ten countries for which no debt crises were preindicated are: Argentina, Colombia, Guyana, Malawi, Mauritius, Niger, Nigeria, Rwanda, Tunisia, Uruguay.

Table 3
Indicators Tested by Frank/Cline and Feder/Just

Indicators	Frank/Cline ¹	Feder/Just ¹
1. Debt service ratio	(x)	(x)
2. Index of export fluctuations	x	—
3. Compressibility of imports	x	x
4. Imports/GNP	x	x
5. Imports/reserves	x	(x)
6. Capital inflow/debt service	—	(x)
7. Amortization/debt	(x)	(x)
8. Per-capita GNP	x	(x)
9. Per-capita GNP growth	—	x
10. Growth of exports	x	(x)

¹ x: Indicator tested in the studies; (x): Variables used in the most accurate *ex-post* prognostications.

considered in their inquiry (see Table 3). By making use of the discriminant analysis Frank and Cline establish a function of $Z = f(X)$ in which X is the vector of indicators. A critical value of Z^+ is determined iteratively for the index Z . A country with Index $Z = f(X) > Z^+$ is included in the group of rescheduling countries. Unlike Petersen, Frank and Cline thus do

not fix rigid critical values for individual indicators. In *ex-post* predictions they obtained the best results with a discriminant function containing no more than two variables: debt service ratio and the ratio of annual amortization to total debt. Using this function, they correctly categorized all 13 debt rearrangements; 12 of altogether 145 observations were however falsely included among the cases of debt reschedulings.

The Feder/Just Method

The study of Feder and Just comprises 41 countries including 11 with altogether 21 defaults. It relates to the period from 1965 till 1972, and the number of observations was 238. Using another statistical procedure (logit analysis) the authors designed a probability index for debt rearrangements: $P = P(X)$ in which X stands for the vector of indicators. They regard their method as an advance on others insofar as the design of a probability index avoids initially the somewhat absurd assumption that a country crossing a certain threshold thereby changes abruptly from an unproblematic case into a problematic one. As however the index alone does not allow any forecasts to be made, Feder and Just take a second step by which they also introduce critical values thus vitiating the initially claimed advance. The Feder-Just probability index has however proved surprisingly insensitive to variations of the critical value. In regard to their best forecasting function which comprises six indicators (designated in Table 3 by brackets) no value between 0.1 and 0.9 (the function can have values between 0 and 1) gave more than 10 false classifications. Feder and Just achieved the best result with a threshold of 0.2: in 238 observations all 21 defaults were correctly identified and in six cases only were debt reschedulings erroneously preindicated.

To sum up, it may be said that the cases calling for debt rearrangement were competently identified by *ex-post* predictions in all studies. The "testing" of the indicator systems was however carried out by reference to the cases of rearrangement of debts which were also used for the design of the systems. What prognosticative value the models have in fact cannot be ascertained in this way. Only the application of Petersen's early warning system to more recent cases allows certain conclusions about the quality of this method, and they are ambiguous. All recent debt rearrangements were admittedly indicated by this system but a very large number of others were – incorrectly – preindicated as well. If the system however signals a critical level of indebtedness for almost all countries, it is not particularly surprising to

find the countries in which debts were rescheduled among those thus marked.

Divergent Findings

The individual authors arrived at rather different results concerning the relevance of various indicators. Whereas Petersen for instance in his system attaches no importance to the debt service ratio, it is included in the prognostic functions of the other two studies. Such divergences need cause no surprise. Which indicators seem in the final analysis to be relevant depends first of all on the decision as to which indicators are to be taken into account, how they are to be defined and what statistical sources are to be used. The findings of such studies are also influenced by the choice of countries and observation periods as well as by the definition of the complex of indebtedness problems. Likewise, the chosen analytical techniques have a bearing on the results.

The procedures followed by the various authors will not be discussed here in detail. Any objections which apply only to the suitability of the analytical techniques used hitherto or, for instance, to the choice of countries and the relatively small number of "potential indicators" tested in most inquiries could be removed by further and more comprehensive studies in the future. A more important question seems to be whether the approach as such holds out a promise for the future.

Measurement Without Theory

Of what help are indicator systems in answering the question whether the foreign indebtedness of a country is in danger of reaching critical dimensions? It may be advisable to consider first the meaning of the term "critical dimensions".

Political crises and similar factors can impair a country's credit rating and impose a limit on its ability to contract debts. Disregarding their effect for the moment, there remains the question of what economic factors may impose a limit on a country's foreign debt. A starting point for the determination of such a debt ceiling is the future debt servicing capacity which in turn depends in the long run on the future economic potential of the country and through this indirectly in some part on the use to which the foreign credits are put. As long as the funds raised abroad are employed profitably, i. e. as long as the overall returns from their employment exceed the total cost of the borrowings, they do not, in theory, imperil the country's future debt servicing capacity. To that extent the external indebtedness serves a good purpose and does not give rise to objections. In practice this proposition is

unfortunately of little help because "overall economic profitability" is still a vague concept. Besides, it is still at least doubtful which factors determine the growth and development chances of a country overall. At the beginning of the first development decade shortage of capital was often diagnosed as the sole or else the most important essential obstacle to development but this is no longer the case, at least not in this form. To what extent and in what circumstances foreign capital can improve the growth and development chances of a country still remains largely undecided. Undetermined therefore also remains the question whether and at what point the foreign indebtedness of a country has reached "critical dimensions".

Indicator systems can do little or nothing to help to bring clarity into this complex of questions. They start from a tautologism: that a country can go on servicing its debts as long as it can meet its obligations. Their purpose is to identify economic aggregates which in the past had a correlation with debt crises. The intention is not to find explanations but to draw inferences for the future from past events. Measurement without theory takes the place of economic analysis. Indicator systems may in a way be regarded as evidence for the lack of a theoretical framework for the assessment of a country's borrowing capacity.

A Narrowed-down Problem

It is common practice in the design of indicator systems to narrow down the debt problems conceptually by confining the inquiry mainly to multilateral debt rearrangements. This makes it even more difficult to see the real problem. That debt problems need not necessarily show up openly in multilateral debt rearrangements is ignored. Rescheduling of debts can for instance be avoided by involuntary deferment of vital imports at the price of possibly grave growth shortfalls. Similarly, acceptance of IMF loans subject to stiff economic-policy stipulations may be regarded as evidence of a debt problem.

The fact that multilateral debt settlements are only the tip of the iceberg – i. e. extreme consequences of a debt servicing problem which should for this reason not be regarded as the sole and exclusive indication of the existence of such a problem – is of course not denied by the authors of the indicator systems.

Petersen⁸ widened the concept of debt crisis which he had earlier narrowed down artificially when he turned to the interpretation of his findings. He does not

look on the many wrong predictions as a drawback of his system but indeed as an advantage. It is his view that the basket of indicators is particularly effective precisely because it is quite generally capable of providing pointers to "critical cases". However, if it is agreed that multilateral debt rearrangements are only one of many possible symptoms of indebtedness problems, the question suggests itself why Petersen does not take cognizance of this fact in the design of his model and takes it into account only when interpreting his findings. Attempts at identifying "critical cases" presuppose earlier clear definition of this concept. Otherwise it has to be asked: Of what use are indicator systems in a situation in which almost all developing countries are up against more or less severe debt servicing problems?

Of Little Use for Decision-making

Indicator systems are thus of very limited utility. From the point of view of economic theory they are unsatisfactory because they cannot help much to elucidate connections. Under practical aspects their utility is also very questionable. It seems to have been virtually impossible yet to prove solid correlations between the emergence of debt crises and the trend or dimensions of certain internal or external economic factors.

It is certain that indicator systems cannot help potential lenders to take decisions and should not be used for this purpose. Just as a business enterprise cannot be assessed by reference to a few quantitative criteria, e. g. balance-sheet figures, the future capabilities of a national economy cannot be judged on the strength of a few arbitrarily assembled indicators.

The statistical data basic to the indicator systems are another matter. The detailed information needed for an economic analysis of a particular case can only be obtained by monitoring the changes of these data in the course of time. To look at them solely with the question in mind whether certain critical thresholds have been crossed at a certain time amounts to giving these models a determinative nature. The more attention is paid to systems of this kind – not least for the reason that there are no wholly satisfying alternatives – the greater is the danger that they will turn into self-fulfilling prophecies. A country may become a problem case because it is classified as such.

⁸ Hans J. Petersen: Zur Früherkennung kritischer Verschuldungslagen von Entwicklungsländern (On early recognition of critical debt situations of developing countries), in: Vierteljahrshette zur Wirtschaftsforschung, No. 3, 1977, p. 180 ff.