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On the Determinants of a Country's Creditworthiness: The Case of Israel, 1971 to 1983*

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This paper assesses an economy's default risk on its international debt by considering different approaches, prevalent in the literature. Unlike in multi-country studies, these data comprise reported loans to one economy only. This is useful since the country's macroeconomic development is the common factor in all observations. The study suggests that for Israeli data the traditional approach, stressing an economy's ability to repay the external debt, performed better than the more recent approach emphasizing the borrowing country's costs and benefits from default, reflecting its willingness to repay debt. Policy considerations conclude the study.

I. Introduction

This paper analyzes Israel's creditworthiness in the years 1971 to 1983 in light of the recent literature on this subject. One approach views the default (or rescheduling) on a country's external debt as a choice situation of the borrower, who acts rationally by weighing costs and benefits from debt repudiation (henceforth CBA). The other, referred to here as the debt-service capacity approach (henceforth DSCA), apprehends default as the culmination of an unintended deterioration in the borrower's capacity to service his debt. We suggest that this distinction implies different sets of explanatory variables, depending on the favored view on the determinants of default risk. The sets differ not only with respect to the relevant variables included; but also specific variables, which are said to be

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and costs from debt repudiation (henceforth DR) by allowing the debtor to consider DR as a possible strategy, including its timing. In this model the borrower permanently compares a grand plan of investment-cum-default to one of investment-cum-compliance. The "naive" lenders are assumed not to be aware of any of this, since prior to the moment of default they are supposed to supply any amount of debt at the level of the safe interest rate. The debtor's capital cost is supposed to increase only after default has occurred. The defaulting economy's benefit is the "windfall gain" consisting of the outstanding debt, by which the country's equity capital is assumed to increase. According to Freeman (1979) then, the higher a borrower's long term growth intentions, the less likely is he to repudiate the debt within the planning period, since in that case consumption will be clustered more toward the end of the period and thus discounted more heavily by the higher post-default rate of interest. In reality the increase in the interest rate will probably not be of such discontinuity, but rather endogenously determined by the lender's expectations of default probability.

Eaton and Gersovitz (henceforth EG) (1981a, 1981b) suggest that in absence of legal institutions, able to enforce international loan agreements, breached by soverign governments, the market mechanism emerges in form of a threat of future exclusion from international capital markets. In the extreme case the cost of repudiation to the defaulting debtor is the loss in welfare due to his being forced into autarchy or at best barter in his foreign trade. The benefit resembles that in Freeman, though EG (1981a, 1981b) do not restrict themselves to the investment motive for foreign debt accumulation. According to EG (1981b) the demand for external debt derives from four major motives, namely the consumption, transactions, investment and adjustment motives. The higher the expected cost to the debtor due to intentional repudiation, the lower is his incentive to default, the reverse being true for the benefit from DR.[1]

According to the consumption motive of borrowing, an economy wishing to pursue a steady consumption path, has a strong incentive to secure free access to the foreign capital market. Thus the higher its income variability, the lower will be the incentive of DR (see proposition 4 in EG (1981a). In this context an economy might wish to increase present bor-

[1] According to this view, both the transversality condition (solvency constraint) and the liquidity constraint are assumed to hold at least implicitly, because otherwise debt repudiation cannot be viewed as a choice situation. The transversality condition is stated in Cooper and Sachs (1984, p. 5). It assumes the principal and interest payment on it to be smaller than the discounted sum of future trade balance surpluses at any point in time. The liquidity constraint requires the debt service, and other unavoidable expenditures in each period to be smaller than total foreign exchange receipts.

festing itself either in short-term illiquidity or in a long run problem of the country's economic structure, which eventually ends up in liquidity problems. While the CBA and the literature on optimal debt assume that the debtor's intertemporal budget constraint, which sets a limit to his borrowing facilities, is satisfied, the DSCA deals with its violation, e.g., due to economic mismanagement, unanticipated external shocks or long run structural problems. Conceptually, then, the underlying assumptions of the DSCA and the CBA are mutually exclusive for a debtor country in a given period of time.

In the 1970s there were many studies which improved the more rudimentary growth-cum-debt approach outlined in Avramovic (1964) by the use of more sophisticated statistical procedures. The basic aim of this sort of study is to find empirical regularities, by the help of which debt-servicing problems can be predicted. Frank and Cline (1971), Feder and Just (1977a, 1977b), Saini and Bates (1978), Mayo and Barrett (1978), Sargen (1976, 1977), are but a few of several such studies. The relevant variables are typically chosen ad hoc. Table 1 lists the hypothesized signs of the most commonly represented variables. The letters in parentheses, given next to the sign, indicates if that effect was found to be statistically insignificant (i) or opposite (o) to the hypothesized sign.

The probability of a sudden liquidity crisis diminishes with a higher current GNP, a lower ratio of imports to reserves or GNP and with a lower debt service in percent of exports. Long run solvency is supposed to improve with growth in exports and in output. Furthermore long run solvency is anticipated to improve with increased investment opportunities and a falling debt/output ratio. According to many studies of this type, an economy's ability to adjust to external shocks also deteriorates with increasing export variability, by causing irregularity in foreign exchange receipts. The inflation rate or money supply growth reflect more general indicators of lenders' confidence in the ability of economic management by the borrowing country's authorities. Average debt maturity is somewhat ambiguous, since on the one hand, a long debt maturity ascertains low periodical amortization payments, thus improving creditworthiness in the long run, but on the other hand, creates more rigidity of this flow, since there is not much possibility left for reducing amortization payments by substituting short maturities for longer ones in the short run.

A few remarks to Table 1. Angeloni and Short (1980): Our table includes only their first four equations (see there, Table 1), since the others include a direct measure of default probability, from a regular survey by the "Institutional Investor," on the right hand side of the equation in addition to the other explanatory variables.

ness is derived as a function of the actual capital stock's deviation from the critical capital stock, the latter being defined as that level, which is sufficient to maintain creditworthiness at a given level of expected gross capital inflows and existing outstanding debt. Here the marginal propensity to invest out of net foreign capital inflows may have an ambiguous effect on creditworthiness since such foreign investment not only increases the capital stock, but also causes debt service to rise. In this approach a lenghtening of average debt maturity unambiguously improves creditworthiness, contrarily to other studies, such as Frank and Cline (1971), Angeloni and Short (1980) and Edwards (1984).

Summarizing the various studies, we then suggest the following general specification to represent the DSCA:

$$(2) \quad \pi = \pi(\overset{+}{D}, \overset{-}{R}, \overset{+}{open}, \overset{+}{\sigma_{gs}}, \overset{-}{KPC}, \overset{-}{GNP}, \overset{+}{CPI}, \overset{+}{DSRATIO}, \overset{+}{DTERM})$$

where the additional variables to those in (1) are KPC = per capita capital stocks, GNP = current GNP, CPI = consumer price inflation, DSRATIO = debt-service ratio, DTERM = average debt maturity.

Table 2

COMPARISON BETWEEN THE TWO APPROACHES
(Sign indicates $\partial\pi/\partial x$)

Variables	CBA	DSCA
Debt	+	+
Reserves (e.g., reserves/GNP)	–	–
Openness (e.g., imports/GNP)	–	+
Variance of exports (goods and services)	–	+
Growth of income	–	(–)
Variance of income	–	(+)
Capital stock per capita		–
Marginal productivity of capital	–	(–)
Imports/reserves (reserve adequacy)		+
GNP		–
Inflation rate, money supply growth		+
Debt-service ratio	(+)	+
Noncompressible imports	(–)	+
Average debt maturity		+ *

* Conceivably ambiguous (see above discussion).

respects. To our knowledge it is the first application to concentrate on the loans to a single contry. Thus problems of differing definitions and quality of macroeconomic variables among different countries are avoided. Here these variables are by definition common to all the observations. Furthermore the analyzed data are nearly identical to the total population of this specific type of loans, rather than being a small sample of it.

Out of 524 bank loans received during those 13 years, some 70 percent were on a floating rate basis, mostly from the Eurodollar market. Only 19 contracts were linked to the U.S. prime rate. The Government was the principal borrower over this period with over 80 percent of the floating rate loans. Table 3 summarizes a few facts. Maturities and grace period were usually shorter and spreads usually higher on floating rate loans than on fixed rate loans. This is especially apparent in the summary figures for all years. In other words, the floating rate loans are on average less favorable than the fixed rate loans. It should be emphasized here, that these loans constitute only a small fraction (2.5 percent in December 1983) of the total gross external debt of Israel, most of the which is borrowed at much better terms. However, it does represent the marginal cost of foreign capital to the Israeli economy, relevant for public policy on the foreign debt. Public project appraisal has to account for it even if the specific project is financed by cheaper foreign loans, since this may in itself push other projects to the margin. The dependent variable (r) is calculated as in equation (1A), i.e., as the spread in percentage of the safe rate of interest on the day of contract. The safe rate is defined as the LIBOR for Eurodollar loans and as the PRIME rate for loans from the U.S. capital market. Due to severe discrepancies in the quality of the calculated spreads on fixed rate loans, as compared to reported spreads of the floating rate loans, empirical tests were performed on the latter only, since these data are much more homogeneous.

Several experiments were made to extract the appropriate time lag concerning the macroeconomic information reaching the lending bank's decision makers. We tested four possible lags, namely, one quarter, half a year, three quarters of a year and one year. The best results were achieved by applying a lag of three quarters of a year (see Table 8, Appendix 3).[5] The typical regression equation can be written

$$(3) \quad \ln(r_{nt}) = \alpha_0 + \sum_{k=1}^{K} \alpha_k x_{kT} + \sum_{l=1}^{L} \beta_1 Z_{nlt} + u_{nt}$$

[5] Such a reference period is introduced as following: Any loan granted in the first three quarters of the year is assumed to have been contracted upon the information on macroeconomic developments up to the end of the preceding year. Only in the last quarter is the lender assumed to know the data of the present year.

Table 3 (continued)

	Interest Spread			Loan Maturity (Months)			Grace Period (Months)			Loan Size (US$1,000)		
	All	Floating Loans	Thereof Public	All	Floating Loans	Thereof Public	All	Floating Loans	Thereof Public	All	Floating Loans	Thereof Public
1978	1.73	1.27	1.06	75	54	51	34	22	11	2,663	2,725	3,590
	(31)	(11)	(8)									
1979	0.74	1.22	1.22	45	27	21	23	13	6	2,344	1,654	2,245
	(40)	(30)	(21)									
1980	1.22	1.23	1.23	51	50	50	16	13	12	1,016	706	694
	(81)	(60)	(59)									
1981	0.80	1.27	1.29	44	40	39	12	12	10	2,269	2,019	2,070
	(70)	(70)	(65)									
1982	0.99	1.28	1.21	26	19	7	9	6	2	1,892	1,835	1,737
	(93)	(81)	(63)									
1983	1.24	1.39	1.19	19	14	8	12	8	3	1,493	1,380	1,456
	(88)	(75)	(61)									
All Years*	1.15	1.30	1.22	60	36	30	20	11	7	2,173	1,727	1,804
	(544)	(366)	(295)									

* Includes also 20 loans from years 1961 to 1970.

Source: Comptroller of Foreign Exchange, Bank of Israel.

Table 4

ISRAEL: COMPARISON OF THE PERFORMANCE OF CBA AND DSCA*

Dependent Variable:r	Estimates	
Explanatory Variables	CBA	DSCA
Intercept	–0.201	0.374
	(–3.2)	(3.0)
RPCD (real debt per capita)	0.017	0.017
	(11.5)	(6.7)
RPCR (real reserves per capita)	–0.058	–0.055
	(–8.0)	(–6.3)
OPEN (openness)	0.157	0.273
	(3.7)	(4.0)
VGS (variance of goods and services exports)	4.4E-7	1.8E-6
	(1.4)	(4.9)
MPK (marginal product of capital)	–0.085	
	(–9.4)	
VRGNP (variance of real GNP)	0.664	
	(5.4)	
GRPCY (growth of real GNP)	0.027	
	(8.8)	
KPC (real capital stock per capita)		–0.013
		(–4.1)
DGNPPC (GNP per capita)		–0.048
		(–4.6)
DSRATIO (debt-service ratio)		0.011
		(9.2)
CPI (inflation rate)		4.7E-4
		(3.9)
PUBLIC (dummy for public sector loans)	–0.032	–0.031
	(–6.6)	(–6.4)
EURO (dummy for Euromarket loans)	0.033	0.031
	(3.4)	(3.2)
R^2	0.586	0.593
F-Value	55.59	51.18
Numbers of observations	363	363

* Figures in parentheses below the estimates are t-values.

Table 5

ISRAEL: REGRESSION RESULTS OF EQUATION (3)—THE DSCA

Dependent Variable: log(r)			
Explanatory Variables	Estimates	Explanatory Variables	Estimates
Intercept	−0.53	DSRATIO	0.11
	(−0.4)		(9.4)
RPCD	0.14	CPI	2.3E-5
	(5.9)		(2.0)
RCPR	−0.38	PUBLIC	−0.12
	(−4.6)		(−2.6)
OPEN	2.76	EURO	0.37
	(4.2)		(4.0)
VGS	1.8E-5		
	(5.0)		
KPC	−0.12		
	(−4.1)		
DGNPPC	−0.38		
	(−3.7)		
	$R^2 = 0.514$		
	F-Value = 37.22		

Furthermore, the spread on a particular loan is certainly influenced by the specific risk of a given firm or institution, separately from the sovereign risk which is common to all the loans. Unfortunately on the former risk, no information is available. The fact that the explanatory power hardly reaches 0.60 is probably due to this source of variation. The dummy variable PUBLIC, which indicates whether the loan has been taken by the Government or one of the semi-governmental agencies on the one hand, or by the private sector on the other hand, shows that the risk factor associated with the public sector is significantly below that of the private sector. Furthermore, the loans received in the Euromarket clearly bear a higher risk premium than those taken in the U.S. capital market. As report in Table 6, (R6 to R8) the specific loan's maturity (TERM) and loan size (SUM) are statistically insignficant, whereas the grace period seems to increase risk. Admittedly, the use of the these loan-specific variables assumes that they are predetermined.

Instead of the real per capita stock of capital (KPC), we also tried the long run growth trend of exports (GEXP), and alternatively a measure

which takes consumption rigidities into account (DSR1). Each one enters the regression satisfactorily, though they alter the other variables significance without affecting R^2 by much. This may be due to multicollinearity (R1, R4). Substituting the marginal propensity to invest (MPI) for KPC did not improve the regression results compared to Table 4 (R2). As mentioned earlier, the effect of the average maturity of the total debt is somewhat ambiguous. On the one hand Kharas, focusing mainly on solvency problems, attributes an improvement of creditworthiness to longer maturities (DTERM) and on the other hand in the other empirical articles, a predominantly long term debt affects creditworthiness negatively, due to the short term rigidity, created by such precommitments. Our evidence (R3) supports the latter interpretation. This further confirms the impression, that risk premia reflect liquidity problems more strongly than solvency considerations.

Another problem discussed in FJ (1977b) and also in Edwards (1984) is that of time specific effects. Such effects might exist due to differing market conditions over time. Recalling our previous discussion, monopolistic competition among bankers implies a demand-elasticity term in the intercept as in equation (4). Changing market conditions, such as for example sudden large inflows of Petrodollars into the Euromarket, may be approximated by indroducing time dummies provided the demand elasticity remain constant. Having assumed an information lag of less than one year, this renders our equation just identifiable for most of the lags, despite the fact that the macroeconomic variables are common to all borrowers at a given point in time. Separate time dummies for each year and a trend variable were found to be statistically insignificant. A more selective choice of the years 1973 and 1976 and a period dummy for the years 1980 to 1983 yielded better results. From Appendix 3, Table 9, it can be seen, that the year 1973 with the Yom-Kippur war and the oil crisis added significantly to the risk factor. The period dummy for the early 1980s also adds to the risk premium, a fact which may be linked to the general LDC-debt crisis, which took place approximately in this period.

E. Some Policy Issues

The results of this paper can be applied in several ways. First a creditworthiness-index (c) can be derived, which is based on the bankers' sovereign-risk evaluation, as revealed in the interest spread. Such a measure can be usefully applied as a minimum constraint on macroeconomic planning by the debtor country. Second, the estimated regression coefficients allow us to evaluate the effect of certain policies on the marginal cost of foreign capital and on creditworthiness.

effect on the country's short run liquidity and long run solvency constraints. One possibility is to define critical values for c or its time path, which can be calculated using the estimated coefficients of regressions like that appearing in Table 5.

In view of the importance of reserves as a determinant of creditworthiness, a debtor country may for instance consider borrowing for the sake of reserve accumulation or reserve-pegging (Edwards (1984)). For this purpose we take the total differential of the reduced form (3) (using the estimated coefficients from Table 5). Since gross debt and reserves enter the regression in real per capita terms, we allow for an equal change in gross debt and foreign exchange reserves. A US$100 million loan taken by the Government at a rate of, say, 0.25 percent over the U.S.-prime rate, changes the predicted value of ln(r) by

$$\Delta \ln(r) = 0.14\ (\text{RPCD}) - 0.38\ (\text{RPCR}) - 0.11\ (\text{DSRATIO}).$$

Given our earlier assumption of $\mu = 5$, such a policy improves creditworthiness from 97.5 to 98.1 for the year 1983.

This exercise hinges on the assumption, that such reserve pegging is transitory and of moderate size, since otherwise the model parameters will not necessarily remain stable. As mentioned earlier, this improvement in creditworthiness is probably due to a stronger impact of liquidity aspects on the spread as compared to solvency aspects, the latter affecting the quantity more strongly than the costs of borrowing.

Although the period since 1983 has not been studied here, the present results would suggest an improvement in creditworthiness, due to the sharp fall in the rate of inflation immediately following the stabilization program of 1985 and to the replenishment of foreign exchange reserves since then.

This function's boundedness between zero and one for all values of x, renders it suitable to represent a probability function. It also lends itself easily to regression analysis, since the logarithm of equation (1A) can be written

$$(3A)\quad \ln\left[\frac{i-i^*}{1+i^*}\right]=\ln\left[\frac{\pi(x)}{1-\pi(x)}\right]=\alpha_0+\sum_{k=1}^{K}\alpha_k x_k.$$

FJ (1977b) assume, that the European-market is approximated more accurately by monopolistic competition. Maximizing the lender's expected utility under the assumption, that he knows the borrowing country's demand elasticity ($\mu=|\, i\, L_i/L|$), FJ's respective expression to our equation (8) includes also an element of the demand elasticity and one of risk aversion in the intercept. The latter vanishes in case of risk neutrality. Their study is on cross-sectional data of different countries. In order to account for differing demand elasticities in different countries they apply the variance-components approach, which combines cross-section and time series data, (see also Edwards (1984)). Since our data differ in this respect, there is no need to split up the elasticity term in case of a monopolistic market structure, if this elasticity is stable over the analyzed period.

The existence of quantity constraints on loans may in some instances impair on the inference on sovereign risk from observed interest spreads. Such quotas may be due to different sources, namely to self-imposed quantity constraints by lenders, sometimes referred to as "country limits" or else to the borrowing country's capital controls policy. Endogenously determined country limits by the lending banks are discussed in Eaton and Gersovitz (1981a), Sachs and Cohen (1982), Sachs (1984) and others. Obviously, once a borrowing country has reached its country limit with all the lending banks, then any shifts of the demand curve will change the spread without altering default risk. Several examples are illustrated in the following diagrams.

Figure 1(a) demonstrates the case of lender-imposed country limits, where the spread (i_0-i^*) does reflect country risk while (i_1-i^*) does not, since the correct measure in both cases would be i_3-i^*.[2] In Figure 1(b) the alternative instruments of capital control, namely a quota (K) or a capital import tax (t) do not affect the spread as a signal for country risk, as long as the borrowers have not reached the credit ceilings.

This study, therefore, implicitly assumes that the total market's credit

[2] Notice however that even if credit ceilings are reached, changes in the spread, generated by, say, a reduction in credit ceilings, still remain relevant signals for changes in creditworthiness.

(c) Other definitions:

i	= interest rate on the loan contract.
i*	= LIBOR for loans received in the Eurodollar market or PRIME-rate for loans received in the US-capital market.
π	= probability of default.
c	= creditworthiness index. $c = (1-\pi)\times 100$.
RPCD	= real per capita debt = (E/CP) x gross debt/population,
where E	= official exchange rate, CP = consumer price index.
RPCR	= real per capita official reserves = (E/CP)x(official reserves/population)
GNPPC	= per capita real quarterly GNP (1980 prices)
VRGNP	= Variance of quarterly real GNP from trend, estimated over 5 years.
DGNPPC	= Nominal yearly per capita GNP in dollars, translated into dollars on a quarterly basis.
DGNPY	= yearly aggregated quarterly GNP, denominated in dollars.
OPEN	= (imports + exports of goods and services)/DGNPY.
MPK	= (change in yearly nominal GNP)/(yearly nominal net investment).
MPI	= 1/MPK.
KPC	= capital stock per capita at 1980 prices.
CPI	= annual change in the Consumer Price Index
DSI	= yearly amortization of total debt + total interest payments.
DSR1	= DS1/DSC
where	
DS	= yearly amortization of long and medium term debt + total interest payments.
DSC	= Debt service capacity constrained by a downward rigidity in aggregate consumption. For the formula, see Liviation (1984, p. 810).
DSRATIO	= DS/exports.
DSTRATIO	= DS/(exports + unilateral transfer payments).
DTERM	= (long and medium term gross debt)/total gross debt.
SUM1	= loan size in US$1,000.
GRACE	= grace period of loan in number of months.
TERM	= loan maturity in number of months.
EURO	= Dummy variable with value = 1, if the loan was received in the Euromarket and equal = 0, if not.

Table 9

ISRAEL: TIME DUMMIES

Dependent Variable: ln (r)			
Explanatory Variables	Estimates	Explanatory Variables	Estimates
Intercept	−102.68	TREND	0.05
	(−1.2)		(1.2)
RPCD	0.17	D73	0.63
	(6.0)		(2.3)
RPCR	−0.48	D76	0.15
	(−4.6)		(0.9)
OPEN	3.53	D80a	0.12
	(4.0)		(1.2)
VGS	2.4E-5		
	(5.5)		
KPC	−0.15		
	(−4.7)		
DGNPPC	−0.56		
	(−4.4)		
DSRATIO	0.09		
	(5.2)		
CPI	3.2E-3		
	(2.5)		
PUBLIC	−0.13		
	(−2.8)		
EURO	0.41		
	(4.3)		
		$R^2 = 0.53$	

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