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The Efficiency of Foreign Borrowing: The Case of Poland*

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Abstract

The main objective of this paper is to examine the efficiency of foreign investment borrowing by Poland in the 1970s. That decade was of particular significance in the post-war history of Central and Eastern Europe. For the first time after the World War II, Poland – a major country in the socialist block – opened up to western economies by increasing foreign trade and by taking loans to finance the imports of modern technology and investments. Since there has been a major disagreement about the economic impact of the loans, we make an attempt to resolve this controversy. The considerations are conducted in a macroeconomic model. Based on the econometric analysis, we conclude that the efficiency of foreign investment borrowing was relatively high. It means that the policy of using external sources to finance economic growth was fully justified.

Keywords: foreign borrowing, efficiency of foreign debts, international indebtedness.
Journal of Economic Literature Classification: F34.

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1 Introduction

The borrowing by countries from foreign commercial banks and other institutions has been present in the world economy for a long time. Over the last forty years many countries accumulated large amounts of foreign debts, and a number of them have experienced difficulties in meeting the scheduled repayments. The situation of these debtor countries has been called "debt overhang".[1]

The difficulties in servicing foreign debts have prompted many developing countries to use countertrade transactions to restore, or maintain the balanced trade.[2] That could lead to trade protectionism and a slowdown in international exchange. Therefore it is important to understand the role of foreign borrowing in the financing of economic growth.[3] One of the key questions related to the debt overhang problem is whether the foreign loans obtained by countries have been properly used in the process of financing the economic growth.[4]

The purpose of this paper is to examine the efficiency of foreign investment borrowing in the case of Poland. Foreign borrowing is considered profitable for a country when it helps develop investments that would produce more than the total costs of debt.

There are two major approaches that can be applied in the analysis of foreign debts. The first group of methods is based on a partial equilibrium framework. The second type of analysis is based on a general equilibrium approach.

We believe that the general equilibrium framework is more appropriate for estimation of the efficiency of external borrowing. The reason is that any consideration of efficiency of particular investment projects in the partial equilibrium framework leaves aside the impact of the projects on the total amount of investments in the economy of the country. It is possible that the amount of investment financed from internal sources could decrease (crowding-out effect). Foreign borrowing in this case enables the borrowing country to shift part of domestic resources from investment to additional consumption. Another possibility is for the inflow of foreign capital to attract additional domestic capital and contribute to a non-proportional increase in total investment. Such macroeconomic effects of external borrowing cannot be captured by a microeconomic analysis of investment projects. External effects of every investment make it difficult to estimate macroeconomic benefits resulting from a given project. Hence, the macroeconomic approach should be used to analyze the efficiency of foreign borrowing. In particular macroeconomic models can be used to implement the general equilibrium approach.

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[1] For a discussion of "debt overhang" problem see, for example, Kaneko and Prokop (1993), or Prokop (1991). As shown by Prokop (1992), this problem is quite persistent. Possible resolutions of the international debt overhang have been analysed by, for example, Prokop (1995), and Sachs (2002).

[2] Compare, e.g., Baranowska-Prokop (2003).

[3] For a discussion on external debts and growth see, e.g., Lin and Sosin (2001), or Pattillo et al. (2011).

[4] For an assessment of the relationship between foreign debts and economic growth in developing countries see, for example, Daud and Podivinsky (2011), or Presbitero (2008).

In this paper, we consider a simplified version of a macroeconomic model to analyze the use of foreign borrowing by Poland in the 1970s. That decade was of particular significance in the post-war history of Central and Eastern Europe. For the first time after the World War II, Poland – a major country in the socialist block – opened up to western economies by increasing foreign trade and by taking loans to finance the imports of modern technology and investments.

Economists significantly disagree about the economic impact of the loans taken by Poland in the 1970s. On the one hand, the strategy to use foreign loans to finance many long term investments was highly praised by some economists. On the other hand, it has been argued that the foreign loans were the major source of serious economic crisis that started in Poland at the end of the 1970s. The controversies continue up to now, so it should not be surprising that we would like to make our own attempt to resolve the dispute.

The rest of this article is organized as follows. In the next section, we consider the structure of the macroeconomic model and describe the methodological details of our analysis. Section 3 provides an econometric analysis of the model. The results of the analysis are given in section 4. Concluding remarks close the paper.

2 The method of analysis

2.1 The model of a borrowing economy

The fundamental element of the model of any economy is the production function. It allows to estimate the productivity of capital and to project the growth of domestic product, given the factors of production. However, we have to be aware that the production function is a device that enables to state only limited conclusions due to its purely quantitative relationship between GDP and the factors of production. Furthermore, the production functions are often not properly specified, i.e., the economic growth is subject only to a few factors (e.g., labour and capital), leaving aside many important determinants of GDP, like endowments of natural resources, human capital, social and political framework.

In our model, we will specify the production $Y(t)$ as a function of current and last period capital stock, $P(t)$ and $P(t-1)$, respectively, current employment. $L(t)$, and the amount of debt borrowed two periods ago, $F(t-2)$:

$$Y(t) = g[Y(t), P(t), L(t), F(t-2)]. \tag{1}$$

Including capital stock from two periods seems appropriate because the capital of different vintages differs in productivity. The negative balance of trade (trade deficit) could be considered a factor of production as additionally obtained foreign components and technology should increase the productivity of existing capital. The delay is caused by the process of adjustment to the new technology. In the case of Poland, we estimate the delay to be two years. A balance of trade surplus may also serve as an accelerator for domestic production, because of the increased demand

for exports. Hence, it is the absolute value of the balance of trade which matters in the production function.

The second element in our model of economy is a description of capital formation. Our hypothesis is that the capital stock in the next period, $P(t+1)$, depends on the current GDP, $Y(t)$, the current level of capital stock, $P(t)$, the current number of people employed in the economy, $L(t)$, and the amount of debt borrowed at time $t-2$:

$$P(t+1) = h[Y(t), P(t), L(t), F(t-2)]. \tag{2}$$

Domestic savings are an upward sloping function of GDP, hence the amount of the next period capital stock is influenced by this period production. The presence of $P(t)$ and $L(t)$ in the function $h(\cdot)$ is justified by the fact that investment decisions are based on current capital stock and the number of people employed. We expect that $h(\cdot)$ is increasing in $P(t)$, but decreasing in $L(t)$, because there is a trade off between capital and labour employed in the production process. The inclusion of foreign debt, $F(t-2)$, in the function $h(\cdot)$ is based on the hypothesis that foreign investment borrowing influences the level of capital stock three periods later. In the case of Poland the average time needed for the installation and full capacity achievement process was estimated to be 3 years. Moreover, it is only the absolute value of the balance of trade that matters.

The system of equations (1) and (2) constitutes a simplified version of a macroeconomic model.

2.2 Application of the model

Substituting equation (1) into the formula (2), we obtain a reduced form of the system:

$$Y(t) = g\left[P(t), P(t-1), L(t), |F(t-2)|\right], \tag{3}$$

$$P(t+1) = h\left[Y(t), P(t), L(t), |F(t-2)|\right]. \tag{4}$$

From the system of equations (3) and (4), we can see that our model describes the evolution of capital and income as a function of the initial conditions and the paths of exogenously determined variables $L(t)$ and $F(t-2)$.

In order to estimate incremental growth of GDP caused by foreign investment borrowing, we calculate $Y(t)$ taking different levels of $F(t-2)$. The incremental growth of the GDP obtained as a result of an external borrowing in comparison to the situation of balanced trade, i.e. $F(\cdot) = 0$, can be interpreted as the gross profit from the debt. The efficiency of foreign borrowing will be evaluated by comparing the incremental growth of income to the amount of interest payments and depreciation.

Table 1: The economic data on Poland, 1971-1985.

t	$Y(t)$	$K(t)$	$P(t)$	$L(t)$	$F(t)$
1971	1048.0	2683.0	2748.5	13.698	34.0
1972	1159.0	2814.0	2916.5	13.862	60.0
1973	1284.0	3019.0	3143.0	14.084	108.0
1974	1417.0	3267.0	3437.0	14.380	127.0
1975	1545.0	3607.0	3784.0	14.481	122.0
1976	1650.0	3961.0	4153.0	14.380	154.0
1977	1733.0	4345.0	4551.5	14.423	119.0
1978	1785.0	4758.0	4950.5	14.495	101.0
1979	1744.0.	5143.0	5325.5	14.567	61.0
1980	1639.0	5508.0	5648.5	14.465	72.0
1981	1442.0	5789.0	5890.5	14.436	70.0
1982	1363.0	5992.0	6045.5	13.974	- 29.0
1983	1445.0	6099.0	6178.5	13.862	- 53.0
1984	1526.0	6258.0	6352.0	13.848	- 62.0
1985	1578.0	6446.0	-	13.862	- 32.0

$Y(t)$ = the GDP in billion PLN at 1977 prices
$K(t)$ = the capital stock at the beginning of year t in billion PLN at 1977 prices
$P(t)$ = the average capital stock in billion PLN at 1977 prices
$L(t)$ = the average employment in million of people
$F(t)$ = the foreign borrowing (= trade deficit) in billion PLN at 1977 prices
Source: own calculations based on Rocznik (1972-1986).

3 Econometric analysis of the model

The analysis is based on the information about Polish economy from the period 1971-1985. Poland began the policy of financing investments and economic growth by the use of foreign debts in 1971. By the end of the decade the total amount of accumulated foreign indebtedness reached the level of about $24 billion. Since the benefits of investments are delayed and generated over several years, we decided to choose 1985 to be the ending date for the evaluation of the foreign loans obtained in the 1970s. All data are given in table 1.

The structural form of our model as suggested by economic theory is as follows:[5]

$$Y(t)+\beta_1+\beta_{11}P(t)+\beta_{12}P(t-1)+\beta_{13}L(t)+\beta_{14}[F(t-2)]^2=\varepsilon_{1t}, \tag{5}$$

$$P(t+1)+\alpha_{22}Y(t)+\beta_2+\beta_{21}P(t)+\beta_{22}L(t)+\beta_{23}[F(t-2)]^2=\varepsilon_{2t}. \tag{6}$$

The implied reduced form is given by:

$$Y(t)=-\beta_1-\beta_{11}P(t)-\beta_{12}P(t-1)-\beta_{13}L(t)-\beta_{14}[F(t-2)]^2+u_{1t}, \tag{7}$$

[5] For a guidance through econometric analysis see, e.g., Spanos (1986), or Maddala and Lahiri (2009).

$$P(t+1) = \pi_0 + \pi_1 P(t) + \pi_2 P(t-1) + \pi_3 L(t) + \pi_4 [F(t-2)]^2 + u_{2t}, \qquad (8)$$

where

$$\pi_0 = \alpha_{22}\beta_1 - \beta_2,$$
$$\pi_1 = \alpha_{22}\beta_{11} - \beta_{21},$$
$$\pi_2 = \alpha_{22}\beta_{12},$$
$$\pi_3 = \alpha_{22}\beta_{13} - \beta_{22},$$
$$\pi_4 = \alpha_{22}\beta_{14} - \beta_{23}.$$

The estimated reduced form based on the OLS method is given as:

$$\begin{array}{lccccccccccc} Y(t) = & 4488 & + & 2.4 & P(t) - & 2.32 & P(t-1) - & 282.6 & L(t) + & 0.00271 & [F(t-2)]^2, \\ & (1810) & & (0.6) & & (0.58) & & (139) & & (0.0043) & \end{array} \qquad (9)$$

with the standard errors given in the parentheses, and $R^2 = 0.9782$, $\bar{R}^2 = 0.9637$, $D-W = 2.010$,

$$\begin{array}{lccccccccccc} P(t+1) = & 2986 & + & 2.04 & P(t) - & 1.08 & P(t-1) - & 197.9 & L(t) + & 0.00143 & [F(t-2)]^2, \\ & (1219) & & (0.4) & & (0.4) & & (93) & & (0.003) & \end{array} \qquad (10)$$

with the standard errors given in the parentheses, and $R^2 = 0.9997$, $\bar{R}^2 = 0.9995$, $D-W = 2.169$.

The first step in the direction of ensuring statistical adequacy is to test the reduced form for misspecification. Because all equations of the reduced form have the same set of explanatory variables, it is legitimate to test the model equation by equation.

In order to simplify the presentation let us introduce the following notation:

y_t– the vector of independent variables,
B– the matrix of parameters of the reduced form ,
x_t– the vector of explanatory variables of the reduced form,
u_t– the vector of residuals of the reduced form.

Thus, we have

$$y_t = Bx_t + u_t. \qquad (11)$$

(i) Normality

As a tool for testing normality, we use the Box-Small test:

$$\tau(1) = \begin{bmatrix} t_{21} & t_{12} \end{bmatrix} \begin{bmatrix} 1 & \gamma \\ \gamma & 1 \end{bmatrix}^{-1} \begin{bmatrix} t_{21} \\ t_{12} \end{bmatrix} \qquad (12)$$

being asymptotically Chi-square under the null hypothesis, where:

t_{21} refers to the t-statistics of u_{2t}^2 in the auxiliary regression:

$$u_{1t} = c_0 + c_1 u_{2t} + c_2 u_{2t}^2 + v_{1t}, \qquad (13)$$

t_{12} refers to the t-statistics of u_{1t}^2 in the auxiliary regression:

$$u_{2t} = d_0 + d_1 u_{1t} + d_2 u_{1t}^2 + v_{2t}, \qquad (14)$$

and $\gamma = r(2–3r^2)$, where r is the sample correlation coefficient between u_{1t} and u_{2t}.

In our case $t_{21} = 1.4$, $t_{12} = 0.7$, $r = 0.58$, $\gamma = 0.57$. Using (12) we get $\tau(1) = 1.96$. Since the critical value is $\chi^2_{0.05}(2) = 5.99$, there is no evidence to reject normality of the conditional distribution of dependent variables.

(ii) Linearity

The linearity test is based on the significance of the matrix Γ in the auxiliary regression:

$$y_t = B_0' x_t + \Gamma' \psi_t' + v_t, \tag{15}$$

where $\psi_t = \left(\hat{y}^2_{1t}, \hat{y}^2_{2t}, \hat{y}_{1t}, \hat{y}_{2t}\right)$, the hats referring to the fitted values.

We shall use the F-test; in f_{ij}, the subscript i stays for the type of test, and the subscript j denotes the equation tested. The calculated values are $f_{11} = 3.49$, and $f_{12} = 3.38$, and the critical value is $F_{0.05}(3,3) = 9.28$. Hence, we do not reject the null hypothesis of linearity.

(iii) Homoskedasticity

The homoskedasticity test is based on the significance of the matrix Δ in the auxiliary regression:

$$w_t' = c + \Delta' \psi_t + v_t, \tag{16}$$

where $w_t = (\hat{u}^2_{1t}, \hat{u}^2_{2t}, \hat{u}_{1t}, \hat{u}_{2t})$.

The calculated statistics are $f_{21} = 5.67$, $f_{22} = 2.02$, $f_{23} = 4.57$, and the critical value $F_{0.01}(3,7) = 8.45$. Hence there is no evidence to reject the hypothesis of homoskedasticity.

(iv) Temporal independence

The temporal independence test is based on the significance of matrix D in the auxiliary regression:

$$u_t = B_0' x_t + D' u_{t-1}' + v_t. \tag{17}$$

In our case the calculated F-statistics have the following values: $f_{31} = 0.33$, $f_{32} = 0.63$, and the critical value is $F_{0.05}(2,3) = 9.55$. This result means that matrix D is insignificant in the period under consideration; hence we do not reject the hypothesis of time independence.

Summarizing the above considerations we may conclude that all underlying statistical assumptions of normality, linearity, homoskedasticity and temporal independence are not violated. Thus, we have obtained a statistically valid model.

The next step is to tackle the identification problem. Our model is just identified, and we are able to estimate the parameters of the structural form indirectly from the reduced equations. Such estimation leads to the following results (with the standard errors in the parenthesis):

$$Y(t) = \underset{(1810)}{4488} + \underset{(0.6)}{2.4}\ P(t) - \underset{(0.58)}{2.32}\ P(t-1) - \underset{(139)}{282.6}\ L(t) + \underset{(0.0043)}{0.00271}\ [F(t-2)]^2, \qquad (18)$$

$$P(t+1) = \underset{(404)}{896} + \underset{(0.095)}{0.4657}\ Y(t) + \underset{(0.005)}{0.921}\ P(t) - \underset{(33)}{66.2}\ L(t) + \underset{(0.0019)}{0.00017}\ [F(t-2)]^2. \qquad (19)$$

In the last step, let us observe that our correct statistical model is also theoretically meaningful. In general our theory presented in section 1.1 is confirmed. From (9) we can see that GDP is positively correlated with the existing capital and the squared value of the balance of trade. The small t-ratio of the coefficient at $[F(t-2)]^2$ is signalling multicollinearity in our model. Multicollinearity may not be a problem when forecasting, but in our case we will set hypothetical values for the exogenous variable, so it is important to be aware of possible mistakes. Small changes in $[F(t-2)]^2$ are causing much higher changes in $Y(t)$, which stays in accordance with the theory of the so called balance of trade multiplier. This expresses the change in the efficiency of the production process caused by the change in the balance of trade.

The negative value of the coefficient of $P(t-1)$ means that older capital stock decreases the productivity of the current one.

A little bit surprising seems to be the coefficient at $L(t)$, because its negative value means that any increase in employment decreases the production level. However, in the case of Poland under socialism, the policy of full employment and as a matter of fact, artificially maintained low wages in the economy wee causing serious inefficiencies in the allocation of labour (e.g. overemployment).

From (19) capital stock at time$t+1$ is positively correlated with GDP obtained at time t. The negative sign of the coefficient at $L(t)$ shows that the firms decrease investments when they increase employment. That confirms the existence of a tradeoff between capital and labour. The positive value of the parameter at $[F(t-2)]^2$ in (10) is clear, i.e. the balance of trade is positively correlated with the capital stock three periods later.

4 The economic results

First, we conducted the ex post projection for the period 1973-1984 using the real inflow of foreign capital. Next, we conducted similar projection assuming balanced trade, i.e. $F(t) = 0$. The remaining initial conditions were kept unchanged in both cases. The main results are presented in table 2.

The values of incremental growth of GDP given in the last column of table 2 are significantly positive. Comparing those values to the amount of borrowing given in the last column of table 1, we may conclude that the efficiency of foreign investment borrowing was relatively high. It means that the policy of using external sources to finance economic growth in Poland was justified. The economic crisis that started in Poland at the end of the 1970s was not caused by foreign debts.

Table 2: Ex post projections of investments and production

t	$F(t)=0$		$F(t)$ actual		$R(t)$
	$P(t)$	$Y(t)$	$P(t)$	$Y(t)$	
1973	-	1290	-	1293	3
1974	3455	1442	3462	1456	14
1975	3783	1503	3812	1551	48
1976	4098	1547	4174	1648	102
1977	4400	1564	4560	1721	157
1978	4673	1519	4947	1751	237
1979	4901	1404	5317	1702	297
1980	5073	1265	5625	1603	339
1981	5206	1112	5870	1466	353
1982	5304	1066	6032	1422	357
1983	5431	1115	6193	1462	347
1984	5589	1194	6366	1503	309

$Y(t)$ = the GDP in billion PLN at 1977 prices
$P(t)$ = the average capital stock in billion PLN at 1977 prices
$F(t)$ = the foreign borrowing (= trade deficit) in billion PLN at 1977 prices
$R(t)$ = an increase in GDP due to foreign borrowing in billion PLN at 1977 prices
Source: own calculations based on the estimated model.

The comparison of the actual annual growth rates of GDP with the hypothetical rates of growth in the case when Poland would have decided not to borrow is presented in table 3.

It follows from table 3 that there was a significant positive impact of foreign investment borrowing on the rate of growth of GDP in Poland during the period under consideration.

The presented method of estimating the efficiency of foreign borrowing allows to analyze aggregate figures and does not provide enough inside into the structure of the economy. However, we believe that our method is still useful as a general framework for further investigation of country's external indebtedness.

5 Concluding remarks

The analysis presented in this paper contributes to a long-lasting discussion about the efficiency of foreign borrowing to finance economic growth in Poland during the decade of 1970s. Our results seem to support the position that the use of external sources to finance economic growth in Poland was quite efficient. The impact of foreign loans on the GDP was significantly positive and exceeded the costs of debts.

Nevertheless, Poland - as well as many other indebted countries - experienced serious economic crisis, including major difficulties in meeting debt repayments.

Table 3: Ex post projection of the rate of growth of GDP

t	Rate of growth of GDP (year on year, %)	
	$F(t)$ actual	$F(t) = 0$
1974	12.6	11.8
1975	6.6	4.2
1976	6.3	2.9
1977	4.4	1.1
1978	2.1	- 2.8
1979	- 3.1	- 17.6
1980	- 5.8	- 10.0
1981	- 8.6	- 12.0
1982	- 2.9	- 4.2
1983	2.8	4.6
1984	2.8	7.1

$F(t) =$ the level of foreign borrowing
Source: own calculations based on the estimated model.

However, there must have been other sources of the crisis than the strategy to finance economic growth through foreign loans.

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