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THE UNIVERSITY OF WOLLONGONG
DEPARTMENT OF ECONOMICS

**ARE THE EXTERNAL DEBTS OF DEVELOPING COUNTRIES A
SYMPTOM OR A CAUSE OF ECONOMIC SLOWDOWN?**

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ABSTRACT

In an attempt to resolve the existing controversy about the cause and effect relationship between external debt and economic slowdown, Granger causality tests are conducted with data on twenty-nine highly indebted developing countries in four distinct geographical regions. The results of these tests indicate that the Bulow-Rogoff's proposition, that the external debts of the developing countries are a symptom rather than a cause of economic slowdown, is rejected. They also indicate that the Dornbusch-Krugman's proposition that the external debts lead to economic slowdown is not rejected only in the cases of several Latin-American countries and Sudan. Moreover, a feedback-type relationship is not rejected for thirteen countries. These mixed results imply that there is no general coherent relationship between external debt and economic slowdown and hence there is no unique way to remedy the failing economies of the developing countries.

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I. INTRODUCTION

Since the early 1980s the external debt problem, its causes and implications on economic growth have become major concerns for many developing countries and international institutions for economic development such as the World Bank and the International Monetary Fund as well as for many academic economists. During the past decade it has become apparent that there is a major controversy between two schools of thoughts about the effects of the external debt on economic growth and hence the necessity for an international facility for debt relief. This controversy is highlighted in the "Symposium on New Institutions for Developing Country Debt" which appeared in the winter 1990 issue of the *Journal of Economic Perspectives*.

The first school of thought is represented by Kenen (1990) and Sachs (1990). They have argued that the external debt overhang is a primary cause of economic slowdown in the heavily indebted countries, and hence, there is an urgent need for an international debt relief facility. Their view is based on the underlying rationale given by Krugman (1989) that high government debt-service payments require high tax rates which in turn discourage capital formation and repatriation of flight capital. It is also supported by Dornbusch's (1988) argument that since the government is the main maker of debt-service payments in most of the heavily indebted developing countries, the improving effects of devaluation on the trade balance are small. Devaluation raises the domestic currency costs of servicing the foreign-currency debt, and subsequently increases the budget deficit, raises the growth rate of the money supply, raises the inflation rate, and deteriorates the country's terms of trade.

The second school of thought is represented by Bulow and Rogoff (1990) who have argued that the external debts of developing countries are a symptom of poor economic management and economic growth rather than a primary cause of economic slowdown. They have also argued that the presence of official creditors such as the International Monetary Fund and the World Bank ossified the negotiating position of the private banks in the industrialised countries and the indebted developing countries, and complicated the negotiations between them on debt rescheduling and relief. The presence of these institutions also creates a "free-rider" problem whereby the indebted countries who negotiate the rescheduling of their external debts

in later stages are likely to use the previous arrangements obtained with other indebted countries as a benchmark for obtaining better deals. Thus, enforcing the private banks to reveal a tougher attitude toward countries which negotiate the rescheduling of their debts earlier.

The purpose of our paper is to test the aforementioned polar hypotheses about the causal relationship between the GNP's growth rate and the external debt's accumulation rate. The interpretation of causal relationships between economic growth and external debt accumulation is not simple and should be done with a great deal of caution. This is due to the possibility that economic growth and external debt accumulation rates are affected by common factors such as technological level, organisational structure, incentive scheme, compatibility of resource allocation to the country's comparative advantage, terms of trade, interest rate differential between the country and the rest of the world, etc. Nevertheless, in order to shed more light on the aforementioned controversy and the potential contribution of a new international institution for debt relief to the economic growth of the developing countries, it is useful to subject the issue to statistical tests.

The structure of the paper is as follows. Granger causality tests are conducted for twenty-nine indebted developing countries located in Latin-America and the Caribbean, Asia and the Pacific, sub-Saharan Africa, south Europe and the Mediterranean basin with annual data encompassing the nineteen-year period between 1970 to 1988. Among the countries analysed are those classified by the World Bank as the seventeen Highly Indebted Countries. Section II describes the conceptual framework adopted for conducting the causality tests. Section III reports the results of these tests and the long-term effects of the external debt accumulation rate and the GNP growth rate on each other. Finally, Section IV concludes the paper with a brief summary of the main empirical findings and their implications.

II. CONCEPTUAL FRAMEWORK

A useful definition of causal relationship between time series has been suggested by Granger (1969). By this definition X causes Y if Y_t can be predicted better by using past X_t , than by not using it. That is, X causes Y if the prediction error is reduced by including lags of

X in the regression equation of Y_t as well as lags of Y. A feedback exists between X and Y if X causes Y and Y causes X.

Following a widely accepted approach we assume that the GNP's time series can be approximated by the exponential growth equation

$$\text{GNP}(t) = \text{GNP}_0 \exp(gt + \varepsilon_t). \quad (1)$$

where g denotes the GNP growth rate, and ε is a white noise (i.e., it is an identically and independently distributed random disturbance with zero mean and finite variance σ_1^2).

Similarly, we assume that the time series of the total external debt (TED) conforms to the exponential equation

$$\text{TED}(t) = \text{TED}_0 \exp(ht + u_t) \quad (2)$$

where h denotes the accumulation rate of TED, and u is a white noise with zero mean and finite variance σ_2^2 .

Granger's causality test is based on the assumption that both time series under consideration are covariance-stationary. That is, the moments of their distributions are time invariant. Recalling equations 1 and 2, as long as g and h are significantly different from zero, the time series of the GNP and TED do not obey the covariance-stationarity assumption. Hence, a certain transformation of these series is required. By taking the logarithmic transformation of these exponential specifications the following regression equations are obtained:

$$\ln \text{GNP}(t) = \ln \text{GNP}_0 + gt + \varepsilon_t \quad (3)$$

$$\ln \text{TED}(t) = \ln \text{TED}_0 + ht + u_t. \quad (4)$$

By taking the first difference of the natural logarithms of these variables we obtain further the following pair of covariance-stationary series:

$$y_t \equiv \ln GNP_t - \ln GNP_{t-1} = g + \varepsilon'_t \quad (5)$$

$$x_t \equiv \ln TED_t - \ln TED_{t-1} = h + u'_t \quad (6)$$

Here,

$$\varepsilon'_t \equiv \varepsilon_t - \varepsilon_{t-1} \quad (7)$$

is a white noise having zero mean and $2\sigma_2^1$ variance, and

$$u'_t \equiv u_t - u_{t-1} \quad (8)$$

is a white noise having zero mean and $2\sigma_2^2$ variance.

It is important to note that y_t and x_t denote the current annual growth rate of GNP and the current accumulation rate of TED, respectively. They fluctuate around the long-term annual growth rates g and h of the original time series GNP and TED. Thus, testing causality between x and y can be meaningfully interpreted as testing causality, in the Granger sense, between the current annual growth rate of GNP and the current annual accumulation rate of TED.

Following Granger's procedure and Akaike's (1969, 1970) final prediction error (FPE) criterion, the test of causal relationships between y and x comprises three stages.¹ The first stage is a search for the autoregressive equations of these variables which have the least FPE. The second stage selects the optimal number of lags of the other variable to be added to the autoregressive equation obtained in the previous stage in order to minimise the FPE. Finally, stage three conducts an F-test of the hypothesis that the set of all the additional lags introduced in the second stage has a significant contribution to predicting the value of the variable under consideration. As an alternative to the FPE criterion, the Hocking (1976) S_p criterion, which can provide an asymptotically optimal choice as to the number of regressors (Breiman and Freedman, 1983), is also applied.²

The estimation of the growth rate and the debt accumulation rate and the regression analyses in the various stages of the causality tests employ the logarithmic transformations of the time series data on GNP in domestic prices of 1980 and the total external debt in U.S. dollars of 1980 for twenty-nine highly indebted countries in Latin America and the Caribbean, Asia-Pacific, sub-Saharan Africa and south Europe and the Mediterranean basin during the period 1970-1988. The data are obtained from the *World Debt Tables 1990-91*, Vol. 2. In view of potential autocorrelation problems, the Cochrane-Orcutt estimation method is applied.

III. EMPIRICAL FINDINGS

Tables 1 to 4 below summarise the estimated long-term growth rate of GNP (g) and long-term accumulation rate of external debt (h) and the causality tests' results for the twenty-nine developing countries by regional affiliation. These tables also present the long-term effects of the external debt accumulation rate and the GNP growth rate on each other for the cases in which the causal relationships between the current rates of growth and debt accumulation are not rejected.³ The hypothesis that the accumulation rate of external debts affects the GNP growth rate is denoted by H_1 and the hypothesis that the GNP growth rate affects the accumulation rate of external debts by H_2 . The results of these hypotheses tests are reported in the tables at the 1 percent level of significance. These hypotheses are also tested at the 5 percent level of significance. Any contradiction between the results obtained in the latter case and those obtained in the former is indicated by an asterisk. The results of the causality tests obtained with the S_p criterion coincide with those obtained with the FPE criterion and hence are not reported.⁴ Further information about the causality tests is provided in Table A.1 in the Appendix.

Tables 1 to 4 indicate that while the GNP long-term growth rates are low, the external debts' long-term accumulation rates are high for all the twenty-nine countries included in the analysis. In this group of developing countries the average long-term annual growth rate is 3.14 percent and its standard deviation is 2.01 percent, whereas the average long-term annual accumulation rate of external debt is 9.80 percent and its standard deviation is 3.89 percent during the observed period 1970-1988. These results are significant at the one percent level in

most cases. Moreover, the fact that the determination coefficients (R^2) are close to one in most cases lends support to the exponential specifications of the GNP and TED time series underlying the definitions of the current annual growth and accumulation rates on which the tests of causal relationships are conducted. The computed correlation coefficient (0.22), as well as the least-squares estimates of the second-order polynomial relationship, between the estimated long-term growth rates and debt accumulation rates indicate that there is no clear statistical association between these long-term rates.⁵ The results of the causality tests are discussed below in a greater detail for the four regional groups of developing countries.

Findings for the Latin-American and Caribbean Countries

The hypothesis that the accumulation rate of external debt affects the GNP growth rate (H_1) is not rejected for 83.33 percent (at the 1% level) to 91.67 percent (at the 5% level) of the countries in Latin America and the Caribbean. Among the countries in which this hypothesis is not rejected it is found that the long-term effect of the external debt accumulation rate on the GNP growth rate is negative in the cases of Bolivia, Brazil, Jamaica, Peru and Venezuela; and also for Argentina at the 5 percent level of significance. The adverse effect of external debt on GNP is mostly noticeable in the case of Brazil where an increase of 1 percent in the external debt leads to a decline of the GNP by 2.77 percent in the long run. This finding lends support to Kenen-Sachs's argument in favour of the establishment of a new institution for debt relief. However, the long-term effect of the external debt accumulation rate on the GNP growth rate is found to be positive in the cases of Chile, Colombia, Costa Rica, Ecuador and Uruguay suggesting a trade off between GNP and level of indebtedness.

The hypothesis that the GNP growth rate affects the external debt accumulation rate (H_2) is not rejected in 50 percent (at the 1% level) to 58.33 percent (at the 5% level) of the countries in Latin America and the Caribbean. Among these countries, the long-term effect of the GNP growth rate on the external debt accumulation rate is found to be negative in the cases of Jamaica, Peru and Uruguay. The effect of GNP growth in alleviating the external debt burden is mostly noticeable in the case of Chile where an increase of one percent in the GNP leads to a decline of the external liabilities by 8.45 percent in the long run. However, in the

Table 1: Long-Term Rates, Causality Test's Results and Long-Term Effects for Countries in Latin America and the Caribbean

Country	Long-Term Rates of		Reject at 1% Level of Significance		Long-Term Effects of	
	GNP growth*	debt accumulation*	H ₁	H ₂	x on y	y on x
Argentina	0.00696 (1.821) 0.569	0.08095 (5.535) 0.974	Yes**	Yes	-0.088	-
Bolivia	0.01557 (1.905) 0.880	0.08048 (6.852) 0.963	No	Yes	-0.041	-
Brazil	0.05126 (5.960) 0.966	0.11368 (4.394) 0.968	No	No	-2.768	0.497
Chile	0.01813 (2.758) 0.693	0.05955 (4.476) 0.957	No	No	0.273	-8.446
Colombia	0.04335 (12.555) 0.992	0.08046 (16.591) 0.961	No	No	0.158	1.125
Costa Rica	0.03299 (5.437) 0.938	0.10393 (5.025) 0.980	No	Yes**	0.331	2.811
Ecuador	0.05814 (5.343) 0.956	0.15529 (4.368) 0.957	No	No	0.109	1.967
Jamaica	-0.01347 (3.093) 0.799	0.02542 (2.668) 0.792	No	No	-0.714	-2.631
Mexico	0.03821 (5.216) 0.970	0.10035 (4.772) 0.977	Yes	Yes	-	-
Peru	0.02114 (5.388) 0.825	0.04930 (4.464) 0.906	No	no	-0.007	-2.939
Uruguay	0.01432 (2.329) 0.805	0.09242 (13.023) 0.952	No	No	0.359	-1.707
Venezuela	0.0200 (3.059) 0.895	0.14902 (3.185) 0.921	No	Yes	-0.755	-

* The numbers in the parentheses are t-ratios and the numbers below the t-ratios indicate the determination coefficients (R^2).

** The opposite conclusion is obtained at the 5 percent level of significance.

cases of Brazil, Colombia, Costa Rica and Ecuador, the GNP growth rate has led to an increase in their levels of indebtedness.

The causality tests in the case of Latin America and the Caribbean do not support the Bulow-Rogoff's proposition that the external debt is a symptom of economic slowdown rather than a cause of economic slowdown. This is because the requirements of Bulow-Rogoff's proposition the H_1 is rejected, that H_2 is not rejected and that the GNP growth reduces the external liabilities, are not met by any of the Latin American and the Caribbean countries.

It is important to note that a feedback relationship between external debt accumulation rate and GNP growth rate is found for 58.33 percent (at the 1% level) to 66.67 percent (at the 5% level) of the Latin American countries including Brazil, Chile, Colombia, Ecuador, Jamaica, Peru, Uruguay and Costa Rica (only at the 5% level).

Finally, the results for Mexico are interesting and unique. In the Mexican case, the tests trace no causal relationship between the GNP growth rate and the external debt accumulation rate.

Findings for the Asia - Pacific Countries

The hypothesis that the accumulation rate of external debt affects the GNP growth rate is not rejected for 60 percent (at the 1% level) to 80 percent (at the 5% level) of the countries in Asia-Pacific. It is interesting that among all the investigated Asia-Pacific countries in which this hypothesis is not rejected (Indonesia, Pakistan, South Korea and the Philippines), the long-term effect of the external debt accumulation rate on the growth rate is positive. This effect is mostly noticeable for Pakistan where an increase of 1 percent in the external debt leads to an increase of the GNP by 0.92 percent in the long run. This finding lends no support to Dornbusch-Krugman's proposition that the external debts of developing countries are a cause of economic slowdown.

The hypothesis that the GNP growth rate affects the external debt accumulation rate is not rejected in 40 percent (at the 1% level) to 60 percent (at the 5% level) of the investigated countries in Asia-Pacific. However, in all of the cases where this hypothesis is not rejected (Pakistan, Philippines and India) the long-term effect of the GNP growth rate on the external

Table 2: Long-Term Rates, Causality Test's Results and Long-Term Effects for Countries in Asia-Pacific

Country	Long-Term Rates of		Reject at 1% Level of Significance		Long-Term Effects of	
	GNP growth*	debt accumulation*	H ₁	H ₂	x on y	y on x
India	0.04211 (16.748) 0.981	0.05068 (5.261) 0.965	Yes	Yes**	-	0.957
Indonesia	0.05911 (13.149) 0.995	0.09639 (7.280) 0.972	No	Yes	0.398	-
Pakistan	0.05325 (13.411) 0.995	0.03287 (7.276) 0.948	No	No	0.921	0.510
Philippines	0.03968 (4.965) 0.964	0.10619 (4.355) 0.968	Yes**	No	0.328	1.247
South Korea	0.08293 (19.345) 0.993	0.10473 (3.584) 0.964	No	Yes	0.712	-

* The numbers in the parentheses are t-ratios and the numbers below the t-ratios indicate the determination coefficients (R^2).

** The opposite conclusion is obtained at the 5 percent level of significance.

debt accumulation rate is positive and hence lends no support to the Bulow-Rogoff's proposition. This effect is mostly noticeable in the case of the Philippines where a 1 percent increase in the GNP leads to a 1.25 percent increase of the external debt in the long run.

Finally, it is important to note that at the 1 percent level of significance, the Indian case reveals no causal relationship between the GNP growth rate and the external debt accumulation rate. In contrast, the Pakistani case indicates that a feedback relationship between the rates of GNP growth and external debt accumulation is not rejected.

Findings for Countries in Sub-Saharan Africa

Table 3: Long-Term Rates, Causality Test's Results and Long-Term Effects for Countries in Sub-Saharan Africa

Country	Long-Term Rates of		Reject at 1% Level of Significance		Long-Term Effects of	
	GNP growth*	debt accumulation*	H ₁	H ₂	x on y	y on x
Cote d'Ivoire	0.03307 (3.995) 0.935	0.16291 (6.663) 0.977	Yes**	Yes**	0.158	-0.843
Ethiopia	0.02240 (11.196) 0.939	0.10065 (24.395) 0.990	No	Yes	0.203	-
Ghana	0.00560 (1.097) 0.359	0.03654 (3.834) 0.800	Yes*	Yes	0.141	-
Kenya	0.05293 (13.349) 0.970	0.09016 (5.555) 0.959	No	No	0.452	0.137
Nigeria	0.02151 (2.373) 0.809	0.18119 (19.234) 0.940	Yes	No	-	5.507
Sudan	0.02850 (3.722) 0.849	0.14125 (5.911) 0.977	No	Yes**	-2.271	1.979
Tanzania	0.02253 (7.102) 0.965	0.10104 (5.156) 0.974	No	Yes**	0.290	2.779
Zaire	0.00407 (1.166) 0.341	0.12366 (3.880) 0.949	Yes**	Yes	0.018	-

* The numbers in the parentheses are t-ratios and the numbers below the t-ratios indicate the determination coefficients (R^2).

** The opposite conclusion is obtained at the 5 percent level of significance.

The hypothesis that the accumulation rate of external debt affects the GNP growth rate is not rejected for 50 percent (at the 1% level) to 87.5 percent (at the 5% level) of the countries in sub-Saharan Africa. Among the countries in which this hypothesis is not rejected it is found that the long-term effect of the external debt accumulation rate on the growth rate is negative only in the case of Sudan. In this case, a 1 percent increase in the external debt leads to a decline of the Sudanese GNP by 2.27 percent in the long run. This finding is compatible with Dornbusch-Krugman's proposition. However, in all other cases (Ethiopia, Kenya and Tanzania, and also Zaire and Cote d'Ivoire at the 5% level) an increase in the external debt accumulation rate leads to a modest rise in the GNP growth rate in the long run.

The hypothesis that the GNP growth rate affects the external debt accumulation rate is not rejected in 25 percent (at the 1% level) to 62.5 percent (at the 5% level) of the countries in sub-Saharan Africa. Among these countries, the long-term effect of the GNP growth rate on the external debt accumulation rate is found to be positive and substantial in the cases of Nigeria, Sudan and Tanzania. This finding does not lend support to Bulow-Rogoff's proposition. The long-term effect of the GNP growth rate on the external debt accumulation is only slightly positive in the case of Kenya and substantially negative for Cote d'Ivoire.

It is important to note that the causality test's results for the sub-Saharan countries do not lend support to the Bulow-Rogoff's proposition. Even in the case of Nigeria, where H_1 is rejected and H_2 is not rejected, the long-term effect of a rise in the GNP growth rate on the external debt accumulation rate is substantially positive. In the cases of Cote d'Ivoire, Ghana and Zaire no causal relationships between the growth rate and the external debt accumulation rate are traced at the 1 percent level of confidence. However, in these cases causal relationships cannot be ruled out at the 5 percent level of significance. Finally, a feedback between the growth rate and the external debt accumulation rate is not rejected in the case of Kenya and also in the cases of Cote d'Ivoire, Sudan and Tanzania at the 5 percent level of significance.

Findings for the South-European and Mediterranean Countries

Table 4: Long-terms rates, causality test's results and long-term effects for countries in south Europe and the Mediterranean Basin

Country	Long-Term Rates of		Reject at 1% Level of Significance		Long-Term Effects of	
	GNP growth*	debt accumulation*	H ₁	H ₂	x on y	y on x
Greece	0.02814 (5.040) 0.957	0.10328 (17.303) 0.978	Yes	No	-	9.146
Morocco	0.04423 (27.247) 0.984	0.12723 (5.416) 0.971	Yes	Yes	-	-
Portugal	0.03117 (9.373) 0.954	0.12014 (4.317) 0.965	Yes	Yes	-	-
Yugoslavia	0.03212 (4.218) 0.959	0.07209 (3.291) 0.950	No	Yes	0.324	-

* The numbers in the parentheses are t-ratios and the numbers below the t-ratios indicate the determination coefficients (R^2).

** The opposite conclusion is obtained at the 5 percent level of significance.

Among the South-European and Mediterranean countries, the hypothesis that the accumulation rate of external debt affects the GNP growth rate is not rejected only in the case of Yugoslavia. In contrast to Dornbusch-Krugman's proposition, the long-term effect of the external debt accumulation rate on the GNP growth rate of Yugoslavia is positive. Similarly, only in the case of Greece the hypothesis that the GNP growth rate affects the external debt accumulation rate is not rejected. In contrast to Bulow-Rogoff's proposition, the long-term effect of the GNP growth rate on the external debt accumulation rate in Greece is positive and large. Finally, it is important to note that no causal relationships between the rate of growth of GNP and the external debt accumulation rate are traced in the cases of Morocco and Portugal.

IV. CONCLUSIONS

The statistical tests of causal relationships between the GNP growth rate and the external debt accumulation rate and the computed long-term effects of the GNP growth rate on the external debt accumulation rate indicate that the Bulow-Rogoff's proposition, that the external debt of the developing countries are just a symptom of economic slowdown, is rejected in all of the twenty-nine highly indebted countries in Latin America and the Caribbean, Asia and the Pacific, sub-Saharan Africa, South Europe and the Mediterranean basin. However, the Dornbusch-Krugman's proposition that the external debt leads to economic slowdown is not rejected only for 50 percent of the investigated countries in Latin America and for Sudan. Moreover, among these countries, the long-term effect of the external debt accumulation rate on the GNP growth rate is substantially large (in absolute value) only in the cases of Brazil, Jamaica, Venezuela and Sudan. The results for thirteen countries out of the twenty-nine (44.83%) indicate the existence of a feedback (bi-directional) relationship between the GNP growth rate and the external debt accumulation rate.

In view of these mixed causality-test's results, it is inadequate to make any type of generalisations of the potential causal relationships between economic growth and external debt. Thus, in designing a recovery policy for alleviating the external debt burden and promoting economic growth, it is necessary to consider the case of each developing country separately. The recovery policy should be based on the country's interrelationships between its GNP and external debt. It should also incorporate the effects of other intervening macroeconomic variables within a system of simultaneous (recursive) equations whenever a feedback (uni-directional) relationship is found. In order to assess the potential long-term effects of external debt and GNP on each other, the system should incorporate dynamic elements.

FOOTNOTES

1. The FPE is computed according to the following formula:

$$FPE = [(T + K) / (T - K)] * SSR/T$$

where T is the number of observations, K is the number of variables on the right-hand side of the regression equation, and SSR is the sum of square residuals.

2. The S_p is computed according to the following formula:

$$S_p = [SSR/(T - K)] [1 + (K/(T - K - 1))].$$

3. The computation of the long-term effect of x on y (LTE_{xy}) is based on the regression equations selected in the second stage of the causality tests by the FPE of S_p criteria. For example, if the selected equation is of the form:

$$y_t = \sum_{i=1}^I \alpha_i y_{t-i} + \sum_{j=1}^J \beta_j x_{t-j} + \text{residual}$$

then the long-term effect of x on y is given by

$$LTE_{xy} = \sum_{j=1}^J \beta_j / (1 - \sum_{i=1}^I \alpha_i).$$

The long-term effect of y on x is computed in an analogous way.

4. The causality tests results obtained with the S_p criterion can be provided by the authors upon request.
5. The least-squares estimates of the parameters of the second-order polynomial relationship between the estimated long-term rates of growth and debt accumulation and their t-ratios are:

$$g_t = \begin{matrix} -0.37715 \\ (0.196) \end{matrix} + \begin{matrix} 0.68453h_t \\ (1.711) \end{matrix} - \begin{matrix} 0.28859h_t^2 \\ (1.475) \end{matrix} + \text{residual}_t$$

$$F = 26.150 \quad \text{and} \quad R^2 = 0.1204.$$

REFERENCES

- Akaike, H., 'Fitting Autoregressive Models for Prediction', *Annals of the Institute of Statistical Mathematics*, Vol. 21 (1969): 243-247.
- Akaike, H., 'Statistical Predictor Identification', *Annals of the Institute of Statistical Mathematics*, Vol. 22 (1970): 203-217.
- Breiman, L. and Freedman, D., 'How many Variables Should Be Entered in a Regression Equation', *Journal of the American Statistical Association*, Vol. 78, No. 381 (March 1983): 131-136.
- Bulow, J. and Rogoff, K., 'Cleaning up Third World Debt Without Getting Taken to Cleaners', *The Journal of Economic Perspectives*, Vol. 4, No. 1 (Winter 1990): 31-42.
- Dornbusch, R., 'Our LDC Debts', in Feldstein, M. (ed.), *The United States in the World Economy*, Chicago, University of Chicago Press for The National Bureau of Economic Research 1988.
- Granger, C.W.J., 'Investigating Causal Relationships by Econometric Models and Cross Spectral Methods', *Econometrica*, Vol. 37 (1969): 425-435.
- Hocking, R.R., 'The Analysis and Selection of Variables in Linear Regression', *Biometrics*, Vol. 32 (1976): 1-49.
- IBRD, *World Debt Tables 1990-91*, Vol. 2, Washington D.C., 1990.
- Kenen, P.B., 'Organizing Debt Relief: The Need for a New Institution', *The Journal of Economic Perspectives*, Vol. 4, No.1 (Winter 1990): 7-18.
- Krugman, P.R., 'Market-Based Debt-Reduction Schemes', In J.A. Frenkel, M.P. Dooley, and P. Wickham (eds.), *Analytical Issues in Debt*, Washington D.C., International Monetary Fund 1989.
- Sachs, J.D., 'A Strategy for Efficient Debt Reduction', *The Journal of Economic Perspectives*, Vol. 4, No. 1 (Winter 1990): 19-30.

APPENDIX

Table A.1 Summary of Results of Granger Causality Tests for the Twenty-Nine Countries

Summary of Results of Granger Test of Causality										
From x to y						From y to x				
Country	m	n	F computed	F critical 1%	F critical 5%	n	m	F computed	F critical 1%	F critical 5%
Latin America & Caribbean										
Argentina	1	6	3.38	5.07	3.09	1	2	2.21	6.36	3.68
Bolivia	7	1	48.61	10.00	4.96	6	1	1.54	9.65	4.84
Brazil	1	7	104.77	5.20	3.14	7	1	31.54	10.00	4.96
Chile	7	1	2072.57	10.00	4.96	5	3	286.70	6.55	3.71
Colombia	1	7	27.71	5.20	3.14	4	4	266.04	5.99	3.48
Costa Rica	1	7	1447.00	5.20	3.14	1	7	468.11	10.00	4.96
Ecuador	1	6	1011.75	5.07	3.09	7	1	3065.96	10.00	4.96
Jamaica	2	5	281.74	5.64	3.33	1	7	126.24	5.20	3.14
Mexico	3	5	2.87	5.64	3.33	7	1	2.68	10.00	4.96
Peru	7	1	10.03	10.00	4.96	1	7	28.62	5.20	3.14
Uruguay	7	1	89.17	10.00	4.96	5	3	96.70	6.55	3.71
Venezuela	1	7	74.55	5.20	3.14	7	1	1.03	10.00	4.96
Asia-Pacific										
India	7	1	1.46	10.00	4.96	1	5	3.68	5.06	3.11
Indonesia	7	1	19.25	10.00	4.96	1	1	1.81	8.13	4.49
Pakistan	3	5	17.40	5.64	3.33	1	6	13.79	5.07	3.09
Philippines	7	1	5.82	10.00	4.96	7	1	25.16	10.00	4.96
South Korea	1	7	18.18	5.20	3.14	7	1	1.90	10.00	4.96
Sub-Saharan Africa										
Cote d'Ivoire	1	1	4.75	8.53	4.49	7	1	5.83	10.00	4.96
Ethiopia	7	1	215.14	10.00	4.96	1	4	2.82	5.21	3.18
Ghana	5	1	6.94	9.33	4.75	7	1	-0.32	10.00	4.96
Kenya	4	4	45.76	5.99	3.48	3	5	281.82	5.64	3.33
Nigeria	4	2	2.61	6.93	3.89	7	1	28.65	10.00	4.96
Sudan	6	2	241.58	7.56	4.10	4	4	5.91	5.99	3.48
Tanzania	2	5	31.25	5.32	3.20	6	2	6.96	7.56	4.10
Zaire	1	6	4.96	5.07	3.09	6	2	3.92	7.56	4.10
South Europe & Mediterranean										
Greece	7	1	0.18	10.00	4.96	1	7	81.27	5.20	3.14
Morocco	6	2	3.13	7.56	4.10	7	1	0.67	10.00	4.96
Portugal	6	1	0.76	9.65	4.84	7	1	-0.49	10.00	4.96
Yugoslavia	7	1	214.78	10.00	4.96	6	1	0.51	9.65	4.84

Here, m and n denote the number of lags of y and x, respectively.

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