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DID THE DEBT CRISIS CAUSE THE INVESTMENT CRISIS?

Andrew M. Warner

ABSTRACT

There is now a large literature which attributes the investment decline in heavily indebted developing countries to the effects of the international debt crisis which began in 1982. However, these theories have not been tested against the alternative that declining terms of trade and high world real interest rates in the early 1980s directly caused the investment declines. This paper is based on the idea that if the debt theories are true, then forecasts of investment in the 1980s which do not use debt variables should not perform very well. This paper points out that such forecasts perform surprisingly well, and in many cases go against the predictions of the debt theories, casting doubt on the validity of the debt theories.

Did the Debt Crisis Cause the Investment Crisis?

Andrew M. Warner[1]

I. INTRODUCTION

The investment decline in heavily indebted less developed countries has stimulated a large literature examining how external debt problems can cause domestic investment to decline. There is general agreement that the international debt crisis, which began in 1982, was caused partly by declining export prices for the indebted countries, high world interest rates, and sluggish growth in industrialized countries. It seems plausible, although rarely stressed in the debt literature, that these same world economic shocks that caused the debt problems in the first place probably also caused a simultaneous reduction in investment demand in these countries. In the absence of further evidence, it is not clear whether the observed investment decline was caused by debt-related effects, or by the world economic shocks directly, or by some interaction between the two.

This paper argues that a clear way to approach this issue is to examine out-of-sample forecasts of investment over the debt crisis period (1982-1989) using equations which incorporate the effects of the world variables mentioned above but do not incorporate debt crisis effects. The essential idea is that these forecasts should not track investment during the debt crisis period if the postulated debt-crisis effects are important but should track investment if they are not. More specifically, if the debt-crisis effects are important, then these investment forecasts which ignore debt-crisis effects should be higher than actual investment.

There are numerous debt-related theories in the literature. The important point for this paper is that,

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[1]The author is a staff economist in the Division of International Finance. This paper represents the views of the author and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff. I am grateful to Olivier Blanchard, Jeremy Bulow, Susan Collins, Neil Ericsson, Maria Hanratty, Steve Kamin, Jeffrey Sachs, Larry Summers, Jeffrey Williamson and other seminar participants at Harvard and the Federal Reserve Board for helpful discussions and comments. Errors remain my own.

despite their diversity, many debt papers agree that 1982 was a watershed year that saw the introduction of investment dis-incentives that did not exist before. Therefore, the prediction that investment from our forecasting equations should exceed observed investment is shared by numerous theories, and these theories can be evaluated together by examining these forecasts.

In the debt-overhang models of Krugman [1988] and Sachs [1988], investment falls because creditors can skim off additional output resulting from capital accumulation, a situation which they argue has prevailed since 1982. Helpman [1988], presents a model where the continued failure to resolve the debt crisis, a failure which prevailed at least up to 1989 when the Brady initiative was announced, raises expectations of future capital taxes, and thus depresses investment. Sachs [1988] also argues that the debt-overhang caused international credit rationing. Rodrik [1989] and others argue that investment has declined because of unprecedented policy uncertainty after 1982, which can reduce investment because of risk aversion or because investment is irreversible as in Cukierman [1980], Bernanke [1983], or Dixit [1989].

A less formal, but equally influential, line of reasoning points to the fiscal problems caused by the drying up of external credit in 1982, and argues further that this caused governments to adjust in ways which depressed investment: by printing money and thus raising the specter of hyper-inflation; by issuing internal debt and thus crowding-out domestic investment; or by forcing domestic banks to hold public debt, thus forcing them to scale back domestic investment loans. These effects are all triggered by the cutoff in international credit to governments in late 1982, and therefore also suggest that new investment dis-incentives prevailed after 1982.

Others attribute the investment decline to international credit constraints directly.[2] Although it is true

[2]This argument is sometimes based exclusively on the balance of payments identity that capital inflows must equal the difference between domestic investment and domestic saving. This identity implies that if saving is held constant, and if capital inflows fall exogenously, then investment must decline. But these assumptions are questionable. Investment and capital inflows could have been jointly determined by falling commodity prices and higher world interest rates.

that indebted countries have been unable to borrow new money from private commercial banks since August 1982, it does not follow from this alone that international credit rationing caused the investment decline. First, investment demand may have fallen simultaneously from deteriorating world economic conditions, so that credit rationing may not have been a binding constraint. For example, in oil-exporting indebted countries like Ecuador, Mexico, Nigeria and Venezuela, the 50 percent fall in oil prices between 1981 and 1986 may have caused investment demand to decline in the absence of a debt crisis or international credit rationing. In addition, other sources of investment financing besides international bank lending were available, including direct foreign investment, or perhaps more significantly, repatriation of flight capital. One problem with the simple credit rationing view is that it fails to explain why we did not observe repatriation of flight capital after 1982. If profitable investment projects did exist in these countries when discounted at the world rate of interest, then its unclear why wealthy Venezuelans failed to repatriate funds from Miami bank accounts to establish equity stakes in domestic firms.[3]

In an empirical study written contemporaneously with this paper, Cohen [1991] pools data for 81 less developed countries and regresses investment as a percent of GDP on population growth, inflation, the ratio of exports to GDP, income per capita, the share of the population in primary school, time and regional dummies and the debt to export ratio in 1982. He finds that both the 82-87 dummy and the debt to export variable have negative coefficients (-1.67 and -0.13) but are not significant (standard errors are 1.90 and 0.69).[4] Cohen interprets this evidence as refuting the simple notion that the accumulated stock of debt represented an investment deterrent, and instead argues that if anything reduced investment it was the forced debt service payments in the 1980s. He estimates this last effect essentially by regressing

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[3]J. Bulow and K. Rogoff have expressed similar scepticism about debt effects in several papers dating back to 1988. Their 1990 paper provides a summary of additional criticisms.

[4]The investment and debt variable are measured in percentage points, and investment is in 1980 constant prices. Tests are not presented for the joint significance of the debt variable and the 82-87 dummy variable. Cohen also presents regressions with growth on the left hand side, but the same independent variables, and actually finds positive debt coefficients.

investment on capital flows and concludes that the effect is statistically significant but small, with an increase of one percent of GNP transferred abroad estimated to reduce investment by 0.3 percent of GDP.[5]

While the Cohen study reaches similar conclusions to this paper, Borensztein [1990], is one study we have found which does not, although he analyzes only one country, the Philippines. He regresses investment on the relative price of investment goods, an estimate of the marginal product of capital, an estimate of the expected real interest rate, and several alternative debt variables. A representative result from his study is that a 1.3 billion dollar debt reduction, equivalent to 3.7 percent of GDP in 1987, is estimated to increase the ratio of investment to GDP by one percentage point. Five of the six debt coefficients he reports are significant, and all are negative.

One potential methodological problem with these studies is that the debt crisis may work through other variables on the right of the regressions. We try to avoid this by using variables that are exogenous to the debt crisis and by using coefficient estimates which are estimated on data prior to the debt crisis. We also try to avoid simultaneity bias by using variables which are exogenous to the country. This paper also differs in that it focusses on the one clear prediction that all debt theories have in common, namely that the investment environment changed fundamentally after 1982.

After reviewing the basic facts in Section 2, Section 3 presents the estimated investment equations. Section 4 presents the forecasts, Section 5 discusses some criticisms and Section 6 concludes.

II. THE FACTS

In the late 1980s, proponents of the debt view typically would point to the fact that investment rates were lower for the heavily indebted group of countries than for other countries to support the debt theories. However, the passage of time and some data revisions have made even this simple comparison

[5]The crucial assumption here is that capital flows are exogenous with respect to investment. Cohen presents instrumental variables estimates, but the instrument list is long so that over-fitting in the first stage regression may be a problem.

less stark, and in addition, it was rarely pointed out that the debt group also experienced more dramatic declines in their export prices than did other countries over the same period. The essential facts are displayed in table I, which shows that investment declined by about 23 percent for the debt group and by 11 percent for all other developing countries. The table also shows that the terms of trade declined by 20 percent for the debt group and only 2 percent for all developing countries. Therefore, unless we adopt the extreme view that a decline in relative export prices had no effect on investment, it is still an open question whether the observed investment decline in heavily indebted countries was due to debt-crisis effects or to the terms of trade decline. Data on the terms of trade by country (Data appendix) show that all of the heavily indebted group with the possible exception of Brazil and Colombia experienced major reductions in their terms of trade in the 1980s.

It is also worth noting that investment declined in Texas and Louisiana in the 1980s as the price of one of their main exports, oil, declined, even though these two economies did not share many of the characteristics, such as sovereign risk or a separate monetary policy, of the heavily indebted group of countries[6]. Table II shows that even in non-petroleum manufacturing real investment fell by 36 percent in Texas and 26 percent in Louisiana between 1982 and 1986. For comparison, real private investment spending (including petroleum) declined 34 percent in Ecuador between 1982 and 1986, and 20 percent in Venezuela between 1982 and 1985. In Mexico, the National Accounts report that real investment declined by 40 percent between 1981 and 1986. A separate investment survey reports that real investment declined by more, about 50 percent, between 1981 and 1985. On balance, the investment declines in these countries are not greatly different from those recorded in Texas and Louisiana.

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[6]I owe the initial suggestion to examine Texas to Jeremy Bulow and Larry Summers.

III. ESTIMATED INVESTMENT EQUATIONS

The forecasts are based on country specific estimates of the following reduced form equation.

$$\ln(\frac{I}{GDP})_t = \alpha_0 + \alpha_1 \ln(\frac{I}{GDP})_{t-1} + (\beta_1 + L\beta_2)P_t + (\delta_1 + L\delta_2)r_t + (\lambda_1 + L\lambda_2)gw_t + \varepsilon_t \qquad (1)$$

Where I is national investment, P is the terms of trade, defined as the ratio of dollar export prices to dollar import prices, or a proxy; r is the 10-year U.S. t-bill rate minus contemporaneous U.S. PPI inflation; and gw is the percentage change in an industrial production index for developed countries, published by the International Monetary Fund.

The variables on the right of this equation are best viewed as instruments for country specific variables which are the more proximate determinants of investment in each country. The reason for including the terms of trade variable is spelled out in the longer version of this paper and in a related paper on Mexico (Warner, [1991]), where it is tested and supported by more extensive investment data. The argument in brief is that these countries basically imported capital equipment and installed it in primarily non-traded sectors. Partial evidence for this statement is in table III.[7] Given this, if a terms of trade deterioration reduces non-traded prices relative to the price of imported machinery, as it will in a wide variety of open economy models, and as the data suggest (Edwards, [1991]), then almost any standard investment model will predict that investment will suffer.

The world real interest rate can be interpreted either as the relevant cost of capital variable itself, or as an instrument for domestic interest rates via an uncovered interest parity condition. And finally, the world growth variable can be interpreted as an instrument for shifts in domestic aggregate demand.

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[7] Table III shows that most of the imports of Latin American heavily indebted countries were either intermediates or capital goods, and further evidence (not in table III) reveals that a large share of machinery investment was imported (for example, 77 percent in Colombia and 78 percent in Venezuela in 1985).

The least squares estimates of equation (1) for each country are presented in table IV. In most cases there are 21 years of available data (the terms of trade variable is usually not available before 1960). To improve efficiency slightly, we dropped the constant term from the specification whenever it was clearly insignificant, as it was in most cases (Argentina and Nigeria were the exceptions). This specification issue turned out to be inconsequential as far as the forecasts were concerned.

The coefficient estimates in table IV show that in 11 of the 13 cases, the estimated short run terms of trade elasticity, given by $\beta_1+\beta_2$, has the anticipated positive sign. In 6 of the 11 cases, it is significant at the 10 percent level. Also in 11 of the 13 cases, the estimated short run real interest rate effect, given by $\delta_1+\delta_2$, has the anticipated negative sign, and is significant in 5 cases. In contrast to these results, the estimated world growth effect, $\lambda_1+\lambda_2$, has the anticipated positive sign in only 6 cases and is significant in only 2. Overall, the evidence in this table provides much stronger support for the terms of trade and world real interest rate variables than for the world growth variable. The estimated world growth effect often has the wrong sign, and when it has the right sign, it is frequently insignificant. There seems to be little supporting evidence that the world growth variable affects national investment after controlling for world interest rate and terms of trade effects. One possible explanation for this result is that shifts in world demand affect national investment only <u>through</u> their effects on export and import prices.

To provide additional information on the size of these estimated effects, panel estimates which pool the data and estimate one equation are presented at the bottom of table IV.[8] These estimates indicate that on average, the estimated short run terms of trade elasticity, $(\beta_1+\beta_2)$, is 0.129 and the estimated long run elasticity, $(\beta_1+\beta_2)/(1-\alpha)$, is 0.662. Similarly, the world real interest rate coefficient implies that a one percentage point rise in the world real interest rate is estimated to change the ratio of investment to GDP

[8]To provide some intuition for the relationship between the individual country estimates and the panel estimates, it can be shown in a simple example with a one variable regression and two countries that the panel coefficient estimate is a weighted average of the country estimates, with weights proportional to the precision of the individual country estimates.

by -1.5 percent in the short run and by -7.8 percent in the long run.

Although the standard errors of the panel estimates of the terms of trade and real interest rate effects are fairly small, they are estimated under the possibly dubious assumption that the coefficients are equal across countries. In contrast, some, but not all, of the country specific equations have large standard errors and poor fits. In general, this imprecision is a cost we are willing to bear in order to achieve exogenous forecasts, somewhat analogous to the sacrifice of efficiency for consistency in classical instrumental variables estimation. It also should be mentioned that we do not ignore this imprecision when forecasting because we will examine stochastic forecasts.

Because it would not make sense to base forecasts on estimated equations with incorrectly signed coefficients, the equations in table IV were re-estimated after dropping some of the variables. Table V presents the final forecasting equations. Since the world growth effect frequently had the wrong sign, many of the forecasting equations do not use this variable, but most use the terms of trade and world interest rate. In two cases, Argentina and the Philippines, one of the exclusion restrictions was rejected but nevertheless imposed to arrive at a final forecasting equation, but in the remaining eleven cases the data did not object to the exclusion restrictions.

IV. INVESTMENT FORECASTS

To be clear about the nature of the forecasts that we will present, consider a simple equation of the form $y_t = \alpha y_{t-1} + \beta x_t + e_t$. Let "T" represent the last year for estimation, (T=1981 in this paper), and let "a" and "b" refer to the point estimates of α and β. The graphs at the end of the paper contain a dark dashed line labelled "Predicted" which is the deterministic forecast, computed as $\hat{y}_{T+1} = ay_T + bx_{T+1}$, $\hat{y}_{T+2} = a\hat{y}_{T+1} + bx_{T+2}$, and so forth. Note that after substituting for $\hat{y}_{T+1}$, the two-step ahead forecast is non-linear in the estimated parameters, $\hat{y}_{T+2} = a^2y_T + abx_{T+1} + bx_{T+2}$, which complicates but does not prevent

calculation of the forecast standard errors.[9]

These forecasts are deterministic because they substitute the point estimates for α and β and because they implicitly set $e_t=0$. We also complement these forecasts with stochastic forecasts computed from Monte Carlo simulations which take into account the fit of the equation and the uncertainty inherent in using estimated parameters. Using the equation above for illustration, we took repeated draws of the parameter vector (α β) from a N[(a b),V] distribution, where V is the estimated variance covariance matrix, and also took repeated draws of the error term e_t from a $N[0,s^2]$ distribution, where s^2 is the estimated variance of e_t. There were 500 draws for the parameter vector and 500*T' draws of the error term, where T' stands for the number of years in the forecast period. For each country, this produced 500 forecast paths, generating an empirical distribution of forecasts from which we obtained confidence bands.[10]

The graphs at the end of the paper plot together three things: Actual investment over GDP (solid line); deterministic forecasts (darker dashed line); and confidence bands which correspond to upper quantiles of the simulated distributions of the forecasts. For example, the 90 percent confidence band in the figure corresponds to the 0.9 quantile of the top half of the simulated distribution. We take quantiles of the top half of the distribution to permit a visual one-sided hypothesis test. The confidence bands allow the reader to guage the strength of the evidence against the debt theories on a time varying, and country by country basis. The finding that actual investment not only lies above predicted investment but even lies above these confidence bands is rather strong evidence against the debt theories because they predict that if anything actual investment should be below forecasted investment.

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[9]Asymptotic standard errors can be calculated for any nonlinear function of estimated parameters by using the multivariate Central Limit Theorem together with the Delta Method. In our application, we found it was faster to program the Monte Carlo simulations presented below.

[10]A third source of uncertainty is the use of a finite number of draws in the Monte Carlo simulations. However, when we repeated the simulations, we found that the quantiles of the simulated distribution did not change very much. Marquez and Ericsson [1990] discuss the statistical issues in more detail.

The graphs show that for 11 of the 13 countries, actual investment does lie above predicted investment for at least one year in the period after 1981. The persistent over-prediction of investment that the debt theories suggest is apparent in only two cases, Argentina and Nigeria. In many countries, predicted investment is substantially below actual investment. Even though some of the estimated equations are imprecise, it does seem striking to observe that predicted investment is lower than actual investment for so many of the group of countries which international organizations have singled out as problem debtors.

These results seem especially surprising in light of the presumption that some sort of debt-crisis effect must exist. If we performed these out-of sample forecasts on 13 countries selected at random, and found that the forecasts were too high for 2, too low for another 3, and about right for the remaining 8, this kind of finding would not support the conclusion that the 13 countries were especially abnormal. If we reflect on the performance of these countries as a group, there does not seem to be strong evidence for debt effects after controlling for the effects of the terms of trade declines and higher world interest rates.

The graphs also show that in the final year of the forecast period, actual investment lies above the 60 percent confidence band in 10 cases; and even lies above the 90 percent confidence band in 3 cases: Brazil, Ecuador and Peru. This is especially strong evidence against debt effects in these three countries; on the other hand, the results for Mexico and Venezuela should be treated with caution, since the confidence intervals are quite wide.[11]

To analyze further how the forecasts performed over time, we computed the average forecast error across all countries for each year, where the forecast error is defined as actual minus forecasted investment. The debt theories would predict negative forecast errors, yet the average forecast error was positive for every year, and indeed rose steadily over the 1980s, indicating perhaps that policy measures

[11]However, the evidence on Mexico in this paper should be superseded by the evidence in Warner [1991], which analyzes far more detailed investment data for Mexico over the debt period and estimates that about two-thirds of Mexico's investment decline was attributable to the terms of trade decline and the remaining third to the termination of capital flows to Mexico. Other more subtle effectS arising from the debt-overhang or uncertainty are estimated to be negligible.

to stimulate investment were having an effect by the end of the 1980s.

The issue of whether we can statistically reject debt-crisis effects was further explored by estimating a panel investment equation over the full sample period, 1961 to 1989, with the same independent variables except for a 1982-1989 intercept dummy to allow for debt effects. The lag specification was similar to the earlier panel estimates except that we dropped the lagged dependent so that this variable would not pick up debt effects during the 1982 to 1989 period, and thus cloud the interpretation of the coefficient on the debt dummy. The point estimate on this dummy, coded to equal 1 for the period 1982-1989, was 0.102, with a standard error of 0.050. The debt theories would predict a negative value for this coefficient, yet it has the opposite sign and is in fact on the margin of statistical significance. This evidence is consistent with the earlier evidence that forecasted investment is not higher than actual investment on average across all of these countries.

We also checked robustness along several dimensions. First, we used real investment per capita from the World Bank rather than nominal investment over GDP from the International Monetary Fund. We scaled by population to eliminate any possible debt effects working through the denominator of the earlier investment over GDP variable. We did not use this World Bank data at first because the sample extends only to 1965, whereas the International Monetary Fund data extends to 1960.[12]

This second set of forecasts, not shown, also reveal predicted investment to be below actual investment for most of the countries and most of the years after 1981. As in the previous forecasts, Argentina and Nigeria are in the debt camp. But unlike the previous forecasts, Mexico, and perhaps Peru, seem to be in the debt camp. With the exception of these two cases however, the results generally reinforce the earlier conclusions.

We also tried replacing our terms of trade data from the International Monetary Fund with World Bank

[12]When this research was completed, Summers and Heston data extended only to 1985. Forecasts with this data up to 1985 did not reveal major discrepancies.

terms of trade data, with the sample once again beginning in 1965 rather than 1960. The forecasts with these data were even more disapproving of the debt crisis hypothesis than the earlier forecasts, since only Nigeria exhibited debt effects.

V. SOME CRITICISMS

One objection might be that terms of trade effects and debt-crisis effects are not separable. For example, the terms of trade declines may impede investment only in the presence of high debt or in the context of restricted international borrowing. But in fact the forecasting exercise sidesteps this criticism because the terms of trade coefficients are estimated on data before the debt-crisis emerged. If this criticism were true, we would be using lower terms of trade coefficients than actually prevailed after 1981, and this error would reveal itself as an over-prediction of actual investment, which in fact we do not find.

Another objection might be that the terms of trade declines in the 1980s are not exogenous to the debt crisis. If an indebted country began to sell more of its exports on the world market to generate foreign exchange to service its debt, then world supply would shift out and export prices would be forced down somewhat. If this happened, then the observed decline in the terms of trade would not be free of debt-crisis effects; nor would our forecasts based on this terms of trade decline.

While this effect is possible in theory, the evidence suggests that supply shifts from indebted countries are not the dominant cause of commodity price declines in the 1980s. A simple supply and demand analysis of world commodity markets would suggest that the size of this effect would be related to the elasticity of world demand, and the size of the shift in world supply, which in turn would depend in part on the market shares of the countries involved. Table VI reports the market shares of several key export commodities for the group of heavily indebted countries, first for the year just prior to the debt crisis, 1981, and then for 1987. The table shows first that the market shares are quite low for some commodities, so that even large shifts in supply from these countries are unlikely to have much effect on the world market price. The table also shows that for some commodities, there is little direct evidence that such

supply shifts really have occurred in the 1980s, because the 1987 market shares are often below and usually not substantially above the 1981 market shares.

Perhaps a more relevant issue is whether the indebted countries have market power as a group rather than individually. The bottom of table VI reports market shares for the four commodities where this is a potential issue. To err on the side of the position we are arguing against, these numbers add the market shares of all developing countries, in effect assuming that they are all affected by the debt crisis, rather than just those in the heavily indebted group. The numbers show that the market shares of developing countries for the four key commodities did not change substantially between 1981 and 1987. We now turn to direct evidence on world quantities and world prices of these commodities to further check the supply shock hypothesis.

The movements in prices and quantities go in the wrong direction for the supply shock hypothesis for three of the four commodities. During 1981-1987, world production of Coffee, Petroleum, and Tin declined while the market shares of developing countries remained fairly stable. Since world prices also fell, the evidence indicates that demand shifts rather than supply shifts dominated these markets in the 1980s. On the other hand, world copper production and the share of output produced by the heavily indebted group both increased over this period while Copper prices fist fell and then recovered. Therefore, it possible that the heavily indebted group drove down Copper prices somewhat in the early 1980s, but for most commodities and countries, the direct evidence is not favorable to the supply shock hypothesis.

VI. CONCLUSIONS

The forecasts in this paper were first conceived as a way to measure the size rather than to question the existence of debt crisis effects on investment. Yet the evidence casts doubt on the existence of debt effects because we fail to detect the systematic over-prediction of investment that the debt theories imply. Instead, the investment declines in many of the countries on the heavily indebted list can be forecasted

out-of-sample by simple terms of trade and world real interest rate equations which do not include debt-crisis effects. In 11 of the 13 countries examined, forecasted investment in the final year of the forecasting period was lower than actual investment. In 10 of the 13 countries, actual investment even lies above the 60 percent confidence band (one-sided) for forecasted investment. Finally, a debt crisis dummy added to panel regressions which pool the data on all of the heavily indebted countries not only fails to have a negative coefficient as the debt theories predict, but actually is positive and significant.

The presumption that debt-crisis effects are needed to explain the investment declines in heavily indebted countries is strongly reduced by the fact that simple forecasts without debt-crisis effects can explain much of the declines. At the very least, the direct influence of world economic shocks in the 1980s on investment in heavily indebted countries has received insufficient attention.

REFERENCES

Bernanke, Ben S., "Irreversibility, uncertainty, and cyclical investment," *Quarterly Journal of Economics*, XCVIII (1983), 85-106.

Borensztein, Eduardo, "Debt Overhang, Debt Reduction and Investment: the case of the Philippines," Working Paper 90/77, International Monetary Fund, September, 1990.

Bulow, Jeremy, and Rogoff, Kenneth, "Cleaning up Third World Debt Without Getting Taken to the Cleaners," *Journal of Economic Perspectives*, Winter, 1990.

Cohen, Daniel, "Slow Growth and Large LDC Debt in the Eighties: an Update," CEPREMAP unpublished manuscript, Paris, October, 1990.

Cukierman, Alex, "The Effects of uncertainty on Investment under risk neutrality with endogenous information, *Journal of Political Economy*, LXXXVIII (1980), 462-475.

Helpman, Elhanan, "Voluntary Debt Reduction: Incentives and Welfare," NBER Working Paper, No. 2692, August 1988.

Krugman, Paul, "Market-Based Debt Reduction Schemes," NBER Working Paper, No. 2587, May 1988.

Marquez, Jaime, and Ericsson, Neil, R., "Evaluating the Predictive Performance of Trade-Account Models," Federal Reserve Board, International Finance Discussion Paper, No. 377, 1990.

Rodrik, D., "Policy Uncertainty and Private Investment in Developing Countries," NBER Working Paper, N 2999, June 1989.

Sachs, Jeffrey, "The Debt Overhang of Developing Countries," in Ronald Findlay, ed., *Debt, Growth and Stabilization: Essays in Memory of Carlos Diaz Alejandro* (Oxford, UK: Blackwell, 1988).

Warner, A., "The Debt Crisis, World Investment Cycles, and American Exports", PhD dissertation, Harvard University, May 1991.

_____, "Did the Debt Crisis or the Oil Price Decline Cause Mexico's Investment Collapse?" *International Finance Discussion Papers*, No. 416, November 1991b.

TABLE I

CHANGES IN INVESTMENT AND THE TERMS OF TRADE, 1980 - 1986

	1980	Mean for 1982 to 1986	Percent change
Investment as a percent of GDP			
Mean for Heavily Indebted Countries	21.90	16.96	-22.5
Mean for all Less Developed Countries	26.50	23.60	-10.9
Terms of Trade Index			
Mean for Heavily Indebted Countries	100.00	79.90	-20.1
Mean for all Less Developed Countries	100.00	98.08	-1.9

Sources. For investment: IMF 1990 Yearbook. For Terms of Trade: IMF 1988 Supplement on Trade statistics.

TABLE II

REAL INVESTMENT IN NON-OIL MANUFACTURING
IN TEXAS AND LOUISIANA

Year	Texas	Louisiana
1982	5761.3	1399.9
1983	3814.0	894.0
1984	4194.4	1022.6
1985	4148.0	1133.0
1986	3677.0	1030.0

In millions of constant 1982 dollars, deflated by the U.S. producer price index for machinery. Source: U.S. Bureau of the Census, Census of Manufactures, 1982, and Annual Survey of Manufactures, 1983 to 1986.

TABLE III

IMPORTS OF CAPITAL GOODS AND INTERMEDIATES AS A SHARE OF ALL IMPORTS
FOR THE 9 LATIN AMERICAN HEAVILY INDEBTED COUNTRIES
(percent of all imports)

	Intermediate inputs[1]		Capital goods[2]		Intermediates plus capital goods	
	1970	1984	1970	1984	1970	1984
BOLIVIA	33	31	34	38	67	61
BRAZIL	49	74	37	17	86	91
CHILE	37	50	42	35	79	85
COLOMBIA	40	50	44	33	84	83
ECUADOR	40	47	38	36	78	83
MEXICO	39	32	46	43	85	75
PERU	37	39	33	32	70	71
URUGUAY	55	71	17	15	72	86
VENEZUELA	35	36	39	37	74	73
Mean:					77	80

[1]Includes industrial supplies and fuels.
[2]Includes machinery, transport equipment for industrial uses, and spare parts.

Source: Latin American Statistical Abstract.

TABLE IV

ESTIMATES OF EQUATION (1)

	α_1	$\beta_1+\beta_2$	$\delta_1+\delta_2$	$\lambda_1+\lambda_2$	R^2	σ	Durbin H	N
ARGENTINA	0.000	-0.418	-0.024	0.047	0.581	0.066	[0.510]a	17
		(0.127)	(0.017)	(0.020)				
BOLIVIA	0.558	0.298	-0.095	0.040	0.684	0.134	[0.331]	18
	(0.160)	(0.114)	(0.034)	(0.030)				
BRAZIL	1.044	-0.069	-0.004	0.049	0.608	0.076	[0.174]a	16
	(0.282)	(0.202)	(0.022)	(0.029)				
CHILE	0.518	0.386	0.080	-0.144	0.101	0.353	[0.144]a	21
	(0.270)	(0.177)	(0.090)	(0.111)				
COLOMBIA	0.826	0.115	0.017	-0.002	0.177	0.083	[0.833]	21
	(0.112)	(0.068)	(0.020)	(0.019)				
ECUADOR	0.921	0.068	-0.046	0.014	0.887	0.083	[0.065]	21
	(0.118)	(0.087)	(0.020)	(0.016)				
MEXICO	0.877	0.082	-0.006	0.003	0.799	0.057	[0.113]a	21
	(0.230)	(0.151)	(0.012)	(0.012)				
MOROCCO	0.745	0.233	-0.026	-0.068	0.773	0.183	[0.155]	21
	(0.138)	(0.102)	(0.043)	(0.039)				
NIGERIA	0.513	0.142	-0.062	0.029	0.767	0.131	[0.740]	21
	(0.212)	(0.105)	(0.032)	(0.047)				
PERU	0.823	0.133	0.021	-0.031	0.574	0.121	[0.419]	21
	(0.126)	(0.079)	(0.027)	(0.031)				
PHILIPPINES	0.893	0.117	-0.024	-0.044	0.929	0.052	[0.427]	21
	(0.039)	(0.031)	(0.011)	(0.016)				
URUGUAY	0.825	0.122	-0.032	-0.018	0.609	0.107	[0.000]	21
	(0.217)	(0.139)	(0.034)	(0.034)				
VENEZUELA	1.022	0.006	-0.025	-0.001	0.759	0.132	[0.936]	21
	(0.116)	(0.080)	(0.030)	(0.038)				
PANEL (b)	0.805	0.123	-0.020	0.010	0.682	0.163	[0.525]	261
	(0.038)	(0.026)	(0.010)	(0.009)				
	0.807	0.129	-0.015	-	0.681	0.163	[0.425]	261
	(0.037)	(0.026)	(0.009)	-				

These are least squares estimates. Standard errors are in parenthesis; significance levels are in brackets. Equation (1), estimated on annual data (1961 through 1981) is:

(1) $\ln(I/GDP)_t = \alpha_0 + \alpha_1 \ln(I/GDP)_{t-1} + (\beta_1 + \beta_2 L)\ln(P)_t + (\delta_1 + \delta_2 L)R_t + (\lambda_1 + \lambda_2 L)gw_t + e_t,$

where I/GDP is investment over GDP, P is the terms of trade, R is the world real interest rate, and gw is the world growth variable. The last two variables are measured in percentage points.

(a) These are significance levels for the lagrange multiplier test for first order serial correlation, based on Breusch (1978) and Godfrey (1978), instead of the Durbin H test, which could not be computed in these cases.

(b) The panel equations include fixed effects dummy variables for each country.

TABLE V

FORECASTING EQUATIONS

	α	$\beta_1+\beta_2$	$\delta_1+\delta_2$	$\lambda_1+\lambda_2$	R^2	σ	Durbin H
ARGENTINA	0.000	0.000	-0.013 (0.017)	0.000	0.047	0.086	[0.182]
BOLIVIA	0.558 (0.160)	0.298 (0.114)	-0.095 (0.034)	0.040 (0.030)	0.684	0.134	[0.331]
BRAZIL	0.946 (0.020)	0.000	0.000	0.042 (0.015)	0.610	0.076	[0.812]
CHILE	0.482 (0.217)	0.304 (0.127)	0.000	0.000	0.006	0.371	[0.089]a
COLOMBIA	0.873 (0.079)	0.086 (0.053)	0.000	0.000	0.268	0.078	[0.464]
ECUADOR	0.921 (0.118)	0.068 (0.087)	-0.046 (0.020)	0.014 (0.016)	0.887	0.083	[0.065]
MEXICO	0.877 (0.230)	0.082 (0.151)	-0.006 (0.012)	0.003 (0.012)	0.799	0.057	[0.113]a
MOROCCO	0.824 (0.140)	0.127 (0.091)	-0.038 (0.042)	0.000	0.745	0.194	[0.154]
NIGERIA	0.513 (0.212)	0.142 (0.105)	-0.062 (0.032)	0.029 (0.047)	0.767	0.131	[0.742]
PERU	0.762 (0.104)	0.150 (0.066)	0.000	0.000	0.599	0.118	[0.063]
PHILIPPINES	0.918 (0.050)	0.063 (0.032)	-0.028 (0.015)	0.000	0.878	0.068	[0.659]
URUGUAY	0.799 (0.160)	0.123 (0.088)	-0.035 (0.025)	0.000	0.585	0.111	[0.661]
VENEZUELA	1.026 (0.057)	0.003 (0.054)	-0.026 (0.024)	0.000	0.784	0.125	[0.837]

Standard Errors are in parentheses; significance levels are in brackets. To derive these forecasting equations, variables were dropped from the equation reported in table IV when the associated (sum of) coefficients had the wrong sign. For Argentina and the Philippines, this entailed imposing a restriction that was rejected by the data on the basis of the estimates in table IV.

(a) These are marginal significance levels for the lagrange multiplier test for first order serial correlation, based on Breusch (1978) and Godfrey (1978). The Durbin-H test was not computable in these cases.

TABLE VI

MARKET SHARES FOR KEY EXPORT GOODS OF
HEAVILY INDEBTED COUNTRIES

Country	Commodity	Percent of World Production	
		1981	1987
BOLIVIA	Tin	10.1	5.5
BRAZIL	Coffee	24.6	34.4
	Iron ore	3.5	4.0
	Soybeans	19.6	17.5
CHILE	Copper	13.0	16.7
COLOMBIA	Coffee	13.4	13.8
ECUADOR	Petroleum	-	
MEXICO	Coffee	3.2	3.8
	Petroleum	4.1	4.5
MOROCCO	Fruits	52.7	26.7
NIGERIA	Petroleum	2.5	2.3
PERU	Copper	3.9	4.7
	Zinc	1.7	2.2
	Lead	1.6	1.3
PHILIPPINES	Coconut	41.7	35.4
	Sugar	2.5	1.2
URUGUAY	Wool	3.0	3.0
VENEZUELA	Petroleum	3.8	3.0
ALL INDEBTED LDCs[1]			
	Coffee	100.0	100.0
	Copper	41.8	44.0
	Petroleum	13.2	12.3
	Tin	20.2	23.3

[1]Includes all non-OPEC less developed countries.

Source: International Financial Statistics Yearbook (1989), and World Commodity Yearbook

DATA APPENDIX

I/GDP Nominal investment over nominal GDP.
Units: Percent.
Source: IMF 1989 International Financial Statistics Yearbook updated with national accounts data from the Oct. 90 IFS.

P This represents either a terms of trade index (export prices over import prices) taken directly from IMF sources or a constructed terms of trade index.

ARGENTINA	Terms of trade
BOLIVIA	Terms of trade
BRAZIL	Terms of trade
CHILE	Ratio of the price of Copper to U.S. machinery prices.
COLOMBIA	Terms of trade
ECUADOR	Ratio of an index of export prices [Petroleum (.69), Coffee (.13), and bananas (.18)] to U.S. machinery prices.
MEXICO	Terms of trade
MOROCCO	Terms of trade
NIGERIA	Ratio of crude petroleum prices (Saudi Arabia) to U.S. machinery prices.
PERU	Terms of trade
PHILIPPINES	Terms of trade
URUGUAY	Ratio of an index of export prices [Wool(.46), Beef(.37), Hides(.17)] to U.S. machinery prices.
VENEZUELA	Ratio of Crude Petroleum prices (Venezuela) to U.S. machinery prices.

Units: Index number, 1980=100.
Source: IFS 1988 Supplement on Trade Statistics for terms of trade data and commodity price indices. The terms of trade for Argentina are from the World Bank.

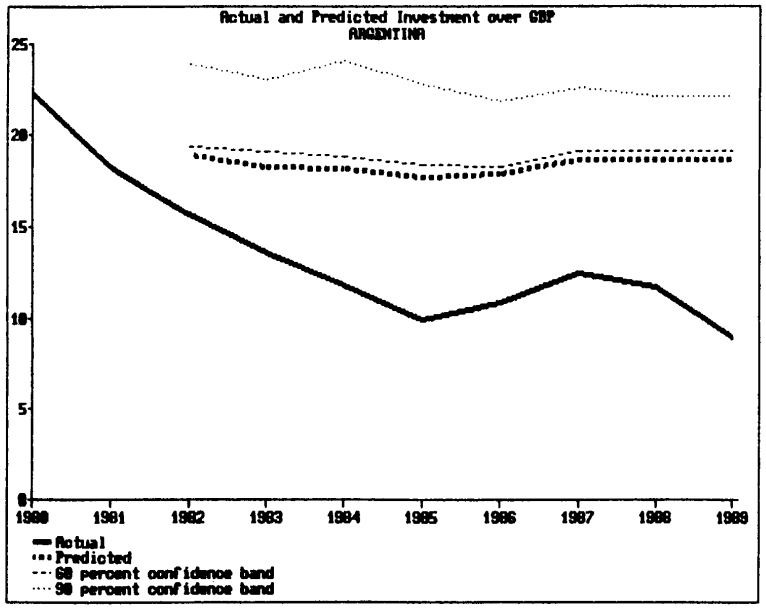
r An ex-post, long term, real interest rate: the 10-year U.S. treasury rate minus contemporaneous U.S. producer price inflation.

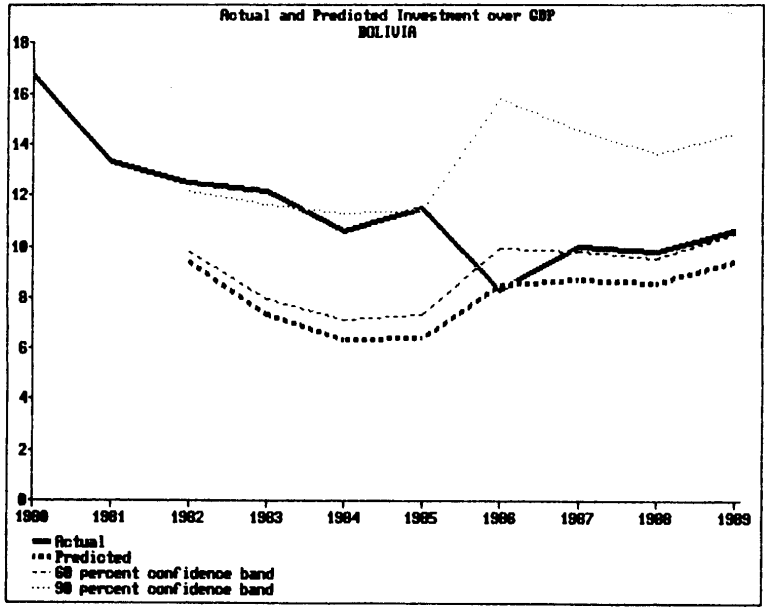
Units: Percent.
Source: Economic Report of the President, 1989, and IFS Yearbook, various issues.

gw Percent change in the IMF's worldwide industrial production index.

Units: Percent.
Source: IMF 1989 International Financial Statistics Yearbook.

Variable	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
P:										
ARGENTINA	100.00	97.93	90.24	96.21	96.97	89.77	85.30	81.76	86.25	-
BOLIVIA	100.00	101.50	100.98	107.20	107.30	106.40	73.90	61.61	59.50	-
BRAZIL	100.00	84.70	82.30	82.20	88.30	88.40	113.33	97.14	118.45	114.80
CHILE	100.00	72.66	58.32	61.02	51.53	52.05	49.56	80.80	90.40	95.52
COLOMBIA	100.00	84.40	81.90	83.90	86.80	86.00	104.70	52.87	81.32	70.80
ECUADOR	100.00	98.96	93.10	83.92	78.34	76.14	50.25	53.03	48.89	54.38
MEXICO	100.00	97.41	84.80	77.43	76.09	72.02	51.41	57.23	46.48	55.06
MOROCCO	100.00	94.00	94.30	87.40	89.40	89.40	93.90	80.90	93.94	91.10
NIGERIA	100.00	103.08	101.06	85.13	81.80	78.20	38.10	48.63	36.99	42.43
PERU	100.00	86.50	78.00	85.30	78.50	73.30	55.70	57.29	65.41	71.74
PHILIPPINES	100.00	88.00	85.60	89.30	87.20	81.40	87.60	95.40	106.80	-
URUGUAY	100.00	84.81	74.59	73.15	74.29	66.65	69.02	88.21	105.34	105.83
VENEZUELA	100.00	105.72	99.86	85.04	80.08	76.83	33.20	46.98	34.81	41.50
gw	2.20	1.60	0.20	2.20	4.90	3.60	3.00	3.60	4.10	
r	2.46	4.21	6.60	7.20	8.74	7.62	4.98	5.09	4.85	


Actual and Predicted Investment over GDP
ARGENTINA
25
20
15
10
5
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
90 percent confidence band


Actual and Predicted Investment over GDP
BOLIVIA
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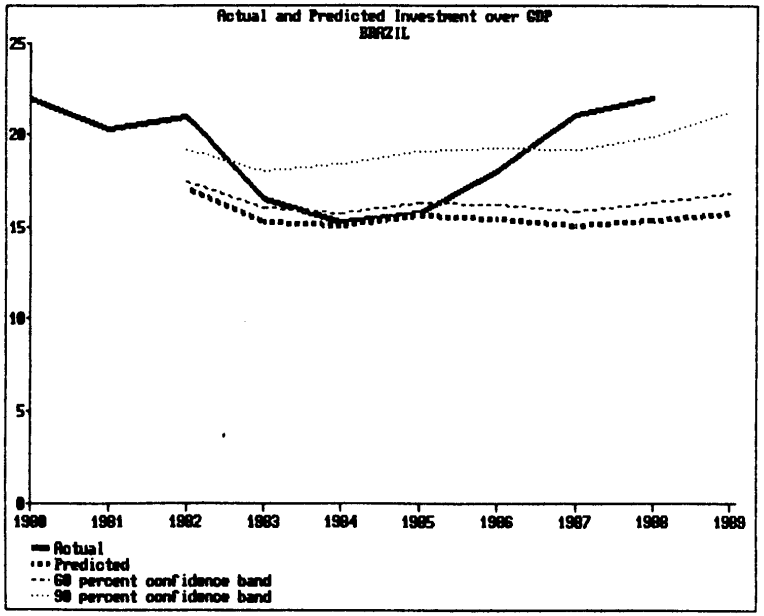
10
8
6
4
2
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
90 percent confidence band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1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
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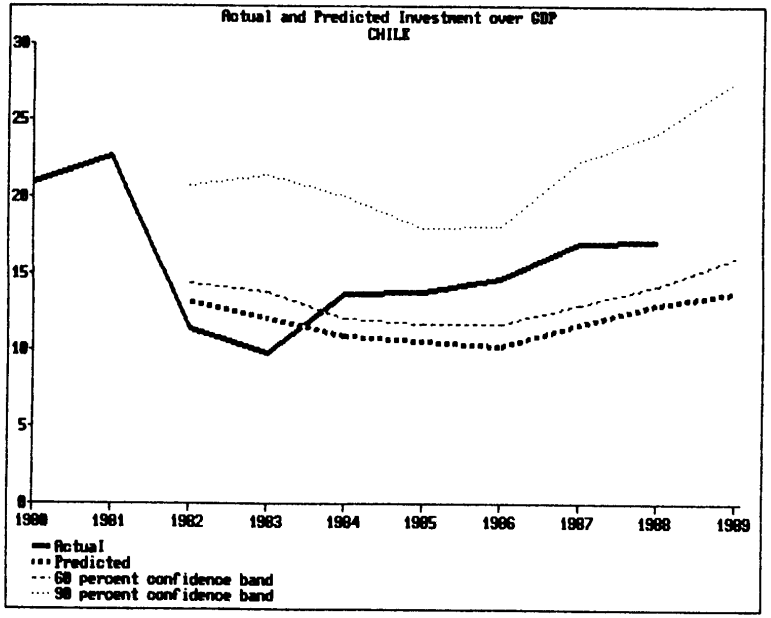
90 percent confidence band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0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
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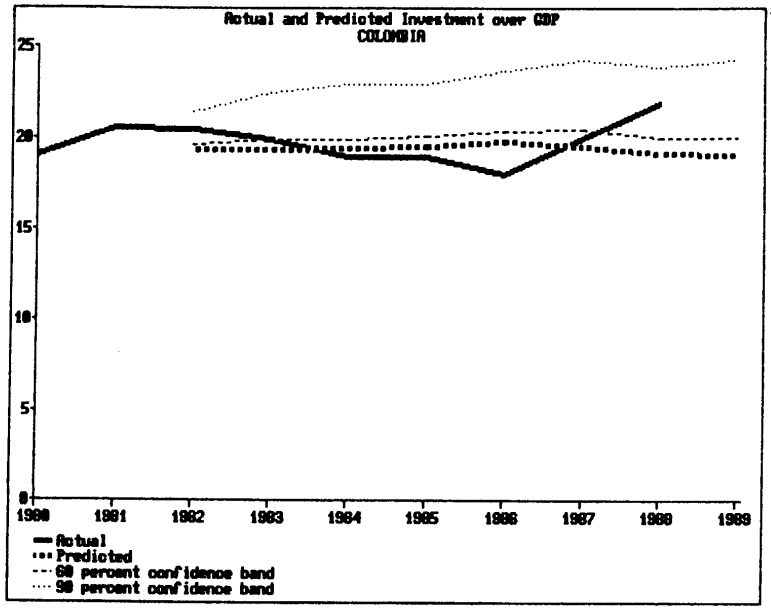
90 percent confidence band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Actual
Predicted
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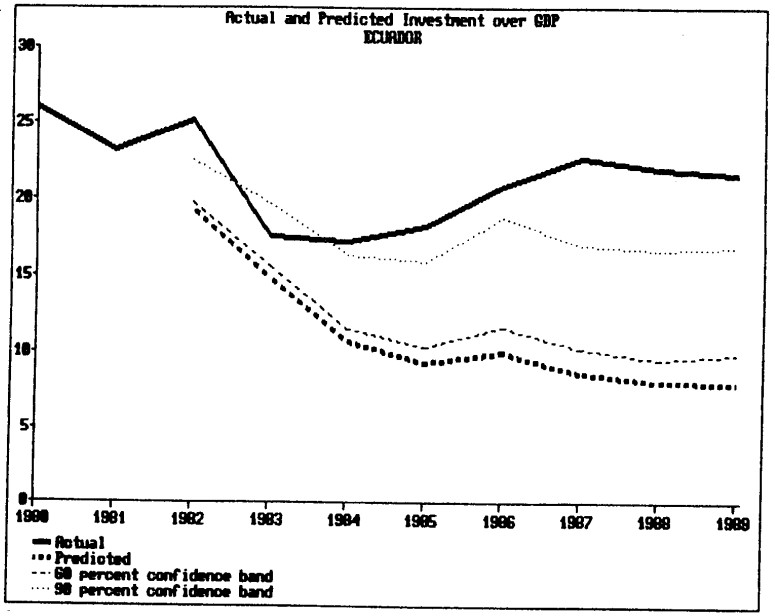
Actual and Predicted Investment over GDP
ECUADOR
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1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
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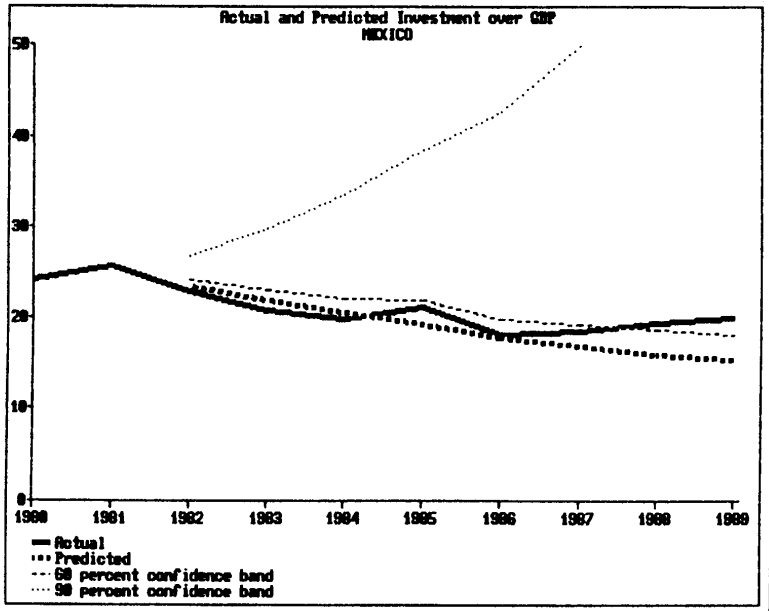
90 percent confidence band


Actual and Predicted Investment over GDP
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Actual
Predicted
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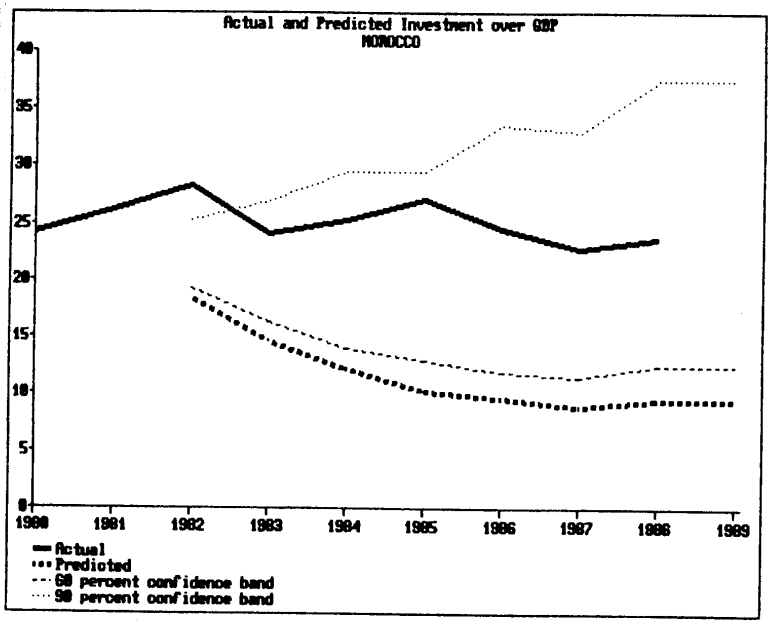
90 percent confidence band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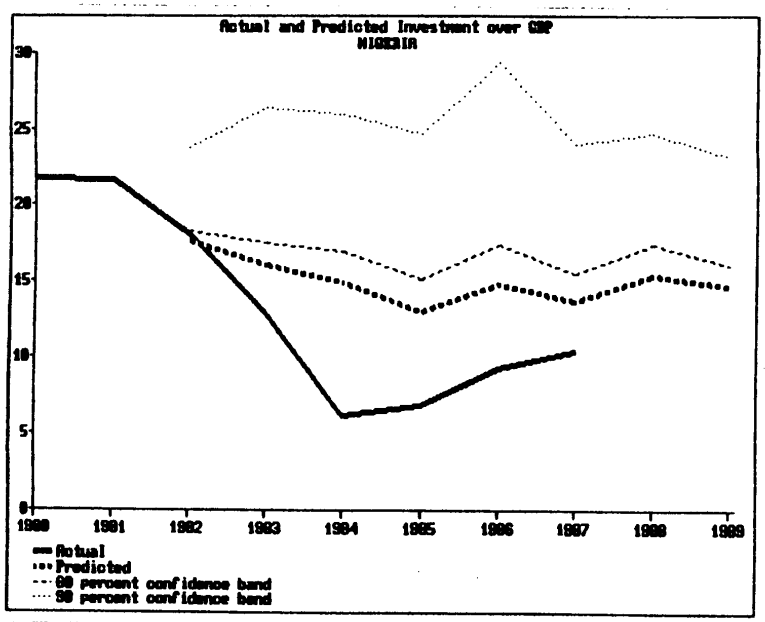
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
90 percent confidence band


Actual and Predicted Investment over GDP
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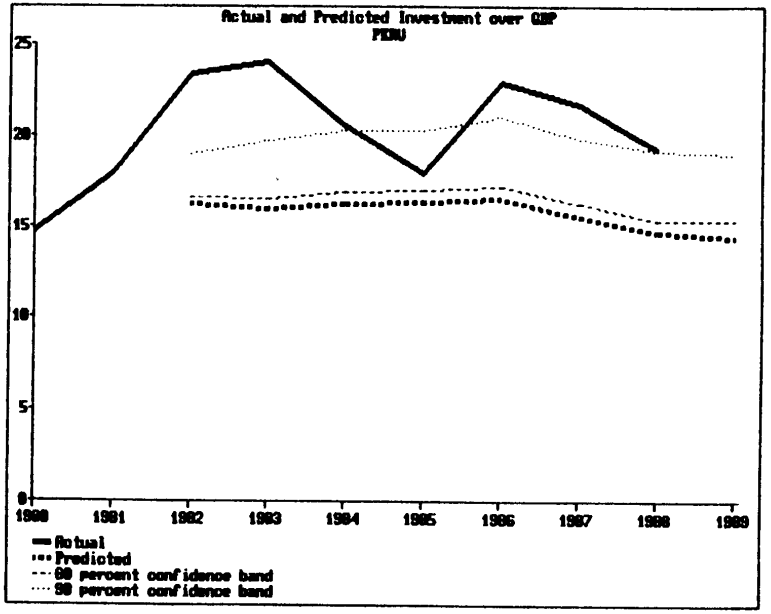
5
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
98 percent confidence band


Actual and Predicted Investment over GDP
PERU
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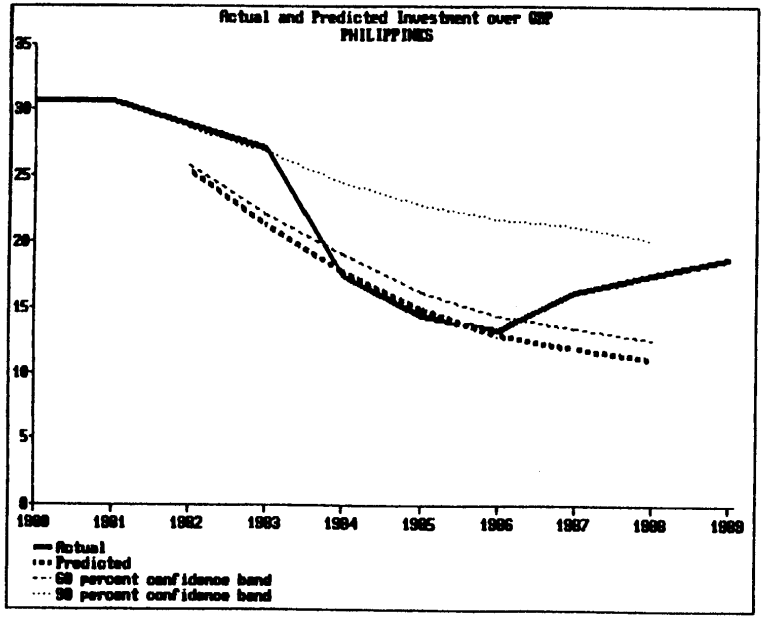
20
15
10
5
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
98 percent confidence band


Actual and Predicted Investment over GDP
PHILIPPINES
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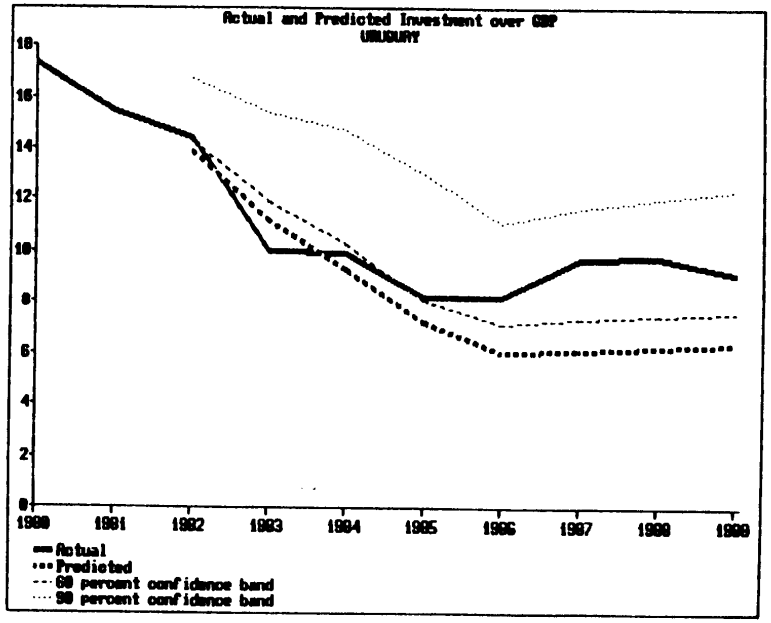
20
15
10
5
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
98 percent confidence band


Actual and Predicted Investment over GDP
URUGUAY
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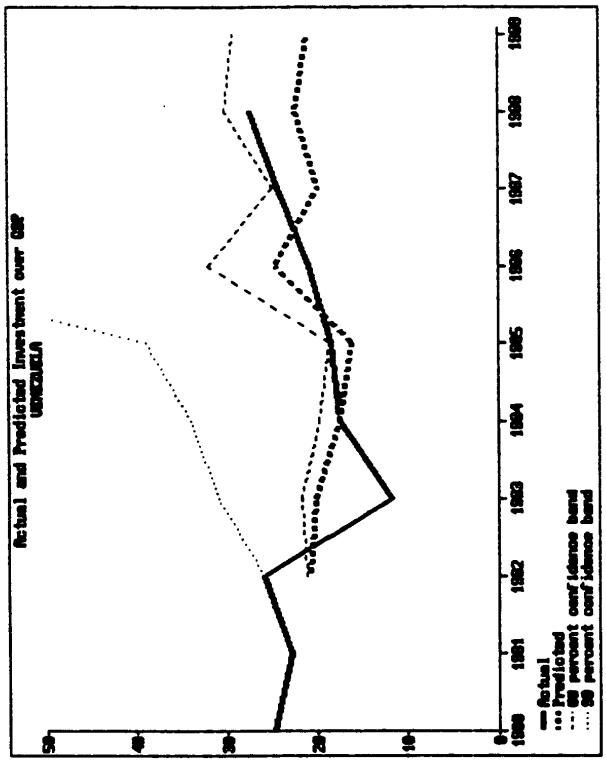
12
10
8
6
4
2
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
Actual
Predicted
68 percent confidence band
98 percent confidence band


Actual and Predicted Investment over GDP
VENEZUELA
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40
30
20
10
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
Actual
Predicted
95 percent confidence band
95 percent confidence band

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