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WORKING PAPERS

Macroeconomic Adjustment and Growth

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A Sensitivity Analysis of Cross-Country Growth Regressions

Ross Levine
and
David Renelt

A vast literature uses cross-country regressions to find empirical links between policy indicators and long-run average growth rates. But conclusions from those studies are fragile if there are small changes in the independent variables.

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This paper — a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department is part of a larger effort in PRE to understand empirically the links between policy and long-run growth. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact CECMG staff, room N11-024, extension 39175 (43 pages, with tables).

A vast literature uses cross-country regressions to find empirical links between policy indicators and long-run average growth rates.

Levine and Renelt study whether the conclusions from existing studies are robust or fragile if there are small changes in the list of independent variables.

Their conclusion: they are fragile.

They find that although "policy" — broadly defined — appears to be importantly related to growth, there is no strong independent relationship between growth and almost every existing policy indicator. Levine and Renelt:

- Find that very few macroeconomic variables are robustly correlated with cross-country growth rates.
- Clarify the conditions under which one finds convergence of per capita output levels.
- Confirm the positive correlation between the share of investment in GDP and long-run growth.
- Conclude that all findings using the share of exports in GDP could be obtained almost identically using the total trade or import share. (Cross-country growth studies that use export indicators should not be interpreted as studying the relationship between exports and growth per se but rather as between growth and trade defined more broadly.)
- Find that many commonly used fiscal indicators are not robustly correlated with growth.
- Highlight the importance of considering alternative specifications in cross-country growth regressions.

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We have received helpful comments from Robert Barro, Surjit Bhalla, Maria Carkovic, David Dollar, Bill Easterly, Dale Jorgenson, Lant Pritchett, Dani Rodrik, Andy Rose, Larry Summers, and seminar participants at Harvard University and the World Bank.

I. Introduction

A large literature uses cross-country regressions to search for empirical linkages between long-run average growth rates and a variety of economic, political, and institutional factors suggested by theory. Most investigators consider only a small number of explanatory variables in attempting to establish a statistically significant relationship between growth and a particular variable of interest. For example, many authors who examine the relationship between measures of fiscal policy and growth ignore the potential importance of trade policy, while those authors who study the empirical ties between trade and growth commonly ignore the role of fiscal policy.[1] Given that over 50 variables have been found to be significantly correlated with growth in at least one regression, readers may be uncertain as to the confidence they should place in the findings of any one study.[2] This paper addresses the question: How much confidence should we have in the conclusions of cross-country growth regressions? We find that few findings can withstand slight alterations in the list of explanatory variables.

We use a variant of Leamer's (1983) extreme bounds analysis to test the robustness of coefficient estimates to the inclusion of other relevant variables. We study a large number of variables that have been used as explanatory variables in a broad collection of growth studies. In examining the strength of the statistical relationship between each variable and growth, we add explanatory variables that have been identified as important by the

[1] Studies of fiscal policy that exclude trade indicators include Landau (1983), Ram (1986), Grier and Tullock (1989), and Barro (1990, 1991). Feder (1983) and Edwards (1989) study trade policy but ignore fiscal indicators. Kormendi and Meguire (1985) and Romer (1990a) include variables for both.

[2] See Levine and Renelt's (1990) review of the empirical growth literature.

empirical growth literature. The relationship between growth and a particular variable of interest is considered robust if it remains statistically significant when other variables are included. Even though we try not to include variables that on a priori grounds measure the same phenomenon as the variable of interest, almost all identified relationships become insignificant with the inclusion of only one additional variable, and many publicized coefficients actually change sign when other explanatory variables are added.

Two themes emerge from our investigation. First, measures of economic policy are related to long-run growth. Taken individually or in groups, there are many cross-country econometric specifications in which macroeconomic policy indicators are significantly correlated with long-run average growth rates.

The second theme is that the cross-country statistical relationships between long-run average growth rates and almost every particular macroeconomic indicator considered by the profession are fragile: small alterations in the "other" explanatory variables overturn past results. In particular, the broad array of fiscal expenditure variables, monetary policy indicators, political stability indexes, human capital and fertility measures considered by the profession are not robustly correlated with growth; and newer indicators that we have assembled to capture exchange rate, tax, and fiscal expenditure policies are also not robustly correlated with growth. This implies that there is not a strong independent statistical relationship between most popular macroeconomic indicators and growth even though "policy" - defined broadly - appears to be importantly related to growth.

Besides demonstrating the fragile relationship between many policy indicators and growth, this paper clarifies the conditions under which one finds evidence of convergence of per capita output levels, confirms the positive

correlation between growth and the share of investment in GDP, and takes some additional steps toward improving our understanding of the complex relationship between trade and growth. We find that the ratio of trade to output is robustly, positively correlated with the investment share which is in turn robustly correlated with cross-country growth rates.

Before detailing the methodology and the results, it is important to emphasize this paper's boundaries. We do not estimate a structural model, establish causal links, identify growth determinants, make policy recommendations, improve the measurement of policy indicators, or run the full gamut of sensitivity analyses discussed by Leamer (1985). We simply examine whether partial correlations that have drawn the attention of a large empirical literature are robust or fragile to small changes in the list of right-hand-side variables. We find that they are generally fragile.

II. Methodology and Data

There does not exist a consensus theoretical framework to guide empirical work on growth. Many researchers begin with a neoclassical production function and add variables that correspond with their views of growth [Feder (1983) and Ram (1986)]. Others use endogenous growth models that highlight a few aspects of growth [Romer (1989) and Barro (1990, 1991)]. Still others use a variety of theoretical models to motivate an assortment of variables that they use in exploratory empirical studies [Kormendi and Meguire (1985) and Grier and Tullock (1989)]. This has produced a diverse and sometimes unwieldy literature, where few studies control for the variables analyzed by other researchers. One common feature of most cross-country growth regressions is that they are linear (see: Barro (1990, 1991), Kormendi and McGuire (1985), Grier and Tullock (1989), but

also see Romer (1989)): researchers regress the average growth rate for a sample of countries on a group of explanatory variables and focus on the coefficients of one or two variables of interest. This paper studies whether we should have much confidence in the conclusions that have been drawn from these regressions.

Since past cross-country studies do not provide much evidence regarding the sensitivity of their findings to small alterations in the list of explanatory variables, this paper uses a variant of Leamer's extreme bounds analysis to examine the robustness of a variety of "findings" described in the empirical growth literature (See Leamer (1983, 1985) and Leamer and Leonard (1983)). We first describe the extreme bounds procedure and then return to discuss and study the empirical growth literature.

As in the studies we are considering, our extreme bounds test is based on linear equations explaining output growth and investment:

$$Y = \beta_i I + \beta_m M + \beta_z Z + u \qquad (1)$$

where Y is either per capita GDP growth or the share of investment in GDP, I is a set of variables that are always included in the regression, M is the variable of interest, and Z is a subset of variables chosen from a large pool of variables identified by past studies as important explanatory variables of growth. Our extreme bounds procedure involves varying the subset of Z-variables included in the regression to find the widest range of coefficient estimates on the variable of interest, M, that is accepted by standard hypothesis tests. In particular, we first choose a variable that has been the focus of past empirical studies, M, and verify the bi-variate sign and significance of these past

findings with our data set. Then we compute the regression results for all possible linear combinations of up to three Z-variables and identify the highest and lowest values for the coefficient on the variable of interest, β_m, that can not be rejected at the 0.05 significance level.[3] The de ree of confidence that one can have in the partial correlation between the Y and M variables can be inferred from the extreme bounds on the coefficient β_m. If the coefficient remains significant and of the same sign at the extreme bounds, then one can maintain a fair amount of confidence in that correlation. In such a case, we refer to the result as "robust." If the coefficient does not remain significant or the coefficient changes sign, then one might feel less confident in the relationship between the M and Y variables. In this case, we refer to the result as "fragile."

One possible objection with this extreme bounds procedure is that it introduces multicollinearity, inflates the coefficient standard errors, and exaggerates the range on the coefficient of interest. Leamer (1978, p.170-181), however, points out that the multicollinearity problem is really a weak-data problem. If one is unable to find robust partial correlations in a cross-section regression it simply means that there is not enough independent variation in that variable to explain cross-country differences in growth. It is only when one identifies a significant correlation <u>while controlling for other relevant variables</u> that one can have much confidence in the correlation.

Nonetheless, we restrict the extreme bounds procedure in two ways to avoid some potential difficulties. First, to the list of variables always included in the extreme bounds regressions, the I-variables, we only allow the procedure to

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[3] We add and subtract two standard errors to each coefficient. Only the actual ß's are reported in the tables with the standard errors.

choose up to three Z-variables from the large pool of variables identified as potentially important for explaining cross-country growth differentials. Consequently, we restrict the total number of explanatory variables included in any one regression to be eight or less.[4] The set of variables from which we draw combinations of Z-variables, however, is larger than that considered by any other investigation. The second way we limit the extreme bounds procedure is that for every variable of interest, M, we restrict the pool of variables from which we choose Z-variables. We exclude variables that, a priori, measure the same phenomenon. For example, when we examine the relationship between growth and the rate of domestic credit creation over the 1960-89 period, we do not allow the inflation rate to be a Z-variable. These restrictions make it more difficult to implicate past findings as fragile.[5]

The data are primarily from the World Bank National Accounts Data Base and, when available, cover the period 1960 to 1989. The data set includes 119 countries but the major oil exporters are excluded from the analysis. Detailed government expenditure and tax information are from the International Monetary Fund's Government Financial Statistics and begin in 1974 for most countries. Data on black market exchange rates, measures of educational attainment, civil liberties, etc. are obtained from a variety of sources listed in the Data Appendix. We also use Barro's (1990, 1991) data set, which is composed primarily of the Summers and Heston (1988) data set, to compare our results with

[4] This total is similar to that used by Kormendi and Meguire (1985) and less than Barro (1991) who uses between eight and fourteen explanatory variables.

[5] Also, before labelling a result as "robust," we conduct additional sensitivity analyses by examining different groups of countries, time periods, and expanding the number of variables that can be included as Z-variables.

other papers. We find similar results with the two data sets, but see Kravis and Lipsey (1990) for a comparison of the two data sets.

III. A Basic Set of Variables for Growth Regressions and Some First Results

The choice of the included variables, I, was based on past empirical studies and economic theory. When the dependent variable is the average annual growth rate in GDP per capita (GYP), the I-variables are the investment share of GDP (INV), the initial level of real GDP per capita in 1960 from Summers-Heston (RGDP60), the initial secondary school enrollment rate as a proxy for human capital (SEC), and the average annual rate of population growth (GPO). Although few empirical studies include all of these variables, most studies control for some subset. Of 41 growth studies surveyed in Levine and Renelt (1990), 33 included the investment share, 29 included population growth, 13 included a human capital measure, and 18 included a measure of initial income. In addition, Mankiw, Romer, and Weil (1990) empirically show that the variables we term "included-variables" enter with the signs predicted by their human-capital-augmented neoclassical growth model, and the included variables are consistent with a variety of "new" growth models that rely on constant returns to reproducible inputs or endogenous technological change [e.g., Barro (1990, 1991) and Romer (1989, 1990a)]. Furthermore, with these I-variables, we can confirm the findings of a large assortment of empirical studies; and, in recognition of the issues raised by McAleer, Pagan, and Volker (1985), we show that small changes in the included variables do not alter this paper's conclusions.

There are statistical and conceptual problems with using these I-variables. In keeping with this paper's focus on assessing the statistical fragility of past findings, we discuss these problems only briefly. Measurement

problems with initial income and secondary school enrollment rates may induce biased results.[6] In the case of population growth, census data may be very poor, and the causal links with per capita output growth are ambiguous [Becker, Murphy, and Tamura (1990)]. Furthermore, in the case of secondary school enrollment rates, human capital represents more than formal schooling, and enrollment rates do not control for educational quality. Nonetheless, other measures of education (primary enrollment, literacy) yield similar results.[7]

There are also problems with including the ratio of physical capital investment to GDP as an I-variable. The causal relationship between growth and investment is ambiguous, and the theoretical justification for including many variables in growth regressions is that they may explain investment. If investment is already included, the only channel through which other explanatory variables can explain cross-country per capita growth differentials is the efficiency of resource allocation. To partially clarify this ambiguity, we investigate the ability and robustness of macroeconomic "variables of interest" to explain the ratio of physical investment to GDP.

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[6] For example, if initial income is mis-measured, the estimated coefficient on initial income will be biased towards being negative. Romer (1989) uses instrumental variables for initial income and the literacy rate and finds that they become insignificant. However, it is unclear that the instruments used (consumption of newsprint and number of radios per capita) are adequate and he uses literacy rates which we find are not as strongly correlated with per capita growth as primary and secondary school enrollment rates.

[7] Secondary enrollment may be preferable to primary and literacy rates because many countries have reached the upper bound for these other measures. A measure of average years of schooling of the labor force around 1980 constructed by Psacharopoulos and Arriagada (1986) was found to be highly correlated with the secondary enrollment ratio.

The regression results with the I-variables over the 1960-89 period are

$$
\begin{array}{lccccc}
GYP = & -0.83 & -0.35*RGDP60 & -0.38*GPO & +3.17*SEC & +17.5*INV \\
(2) & (0.85) & (0.14) & (0.22) & (1.29) & (2.68)
\end{array}
$$

$R^2 = 0.46 \quad n = 101.$

The coefficient standard errors are in parenthesis. The variables have the signs predicted by a wide class of models, and all but population growth are significant at the 0.05 significance level. The I-variables explain about half of the cross-section variance in growth rates.

Table 1 presents extreme bounds tests for each of the I-variables choosing only from the pool of doubtful variables available for the 1960-89 period. The investment coefficient is positive and robust. At the lower bound, the coefficient on the investment share is 12.8 with a t-statistic of 4.2. The investment coefficient remains significantly positive even when we allow the extreme bounds procedure to choose five Z-variables. This robust positive relationship between per capita GDP growth and the investment share is in accord with a wide assortment of growth studies.

A second important finding presented in Table 1 is the robust negative partial correlation between the average per capita growth rate over the 1960-1989 period and initial income in 1960. The coefficient on initial income is often used to test the convergence hypothesis: a poor country - other things equal - tends to grow faster than a rich country.[8] DeLong (1988) and Romer

[8] Another definition of convergence is when the cross-country dispersion of per capita income levels declines over time. Poorer countries growing faster than richer countries will lead toward reductions in dispersion, but new shocks may work in the other direction. See Quah (1990) and Barro and Sala-i-Martin (1990).

(1987), for example, argue that there is little empirical support for convergence. In accord with Barro (1991) and Mankiw, Romer, and Weil (1990), however, we find that there is a robust negative correlation between growth and initial income if one includes population growth, the investment share and either the initial level of secondary school enrollment or the initial level of primary school enrollment as proxies for the initial level of human capital.[9] But, if one excludes initial human capital measures or the investment share, the correlation between growth and initial income is fragile. Thus, although there are specifications that yield evidence of both convergence and non-convergence, we could not overturn the finding of convergence when we included population growth, the investment share and the initial secondary (or primary) school enrollment rates. When we excluded the four fastest and four slowest growers over the 1960-1989 period, the relationship between growth and initial income remained robustly negative.[10] Convergence, however, did not hold very strongly over the 1974-1989 period.

Table 1 also includes extreme bounds tests for the secondary enrollment rate in 1960 and population growth. The secondary school enrollment rate enters with a significantly positive coefficient if the appropriate Z-variables are chosen. But, this proxy for initial human capital enters insignificantly with other plausible specifications.[11] Thus, one should not feel very comfortable

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[9] The coefficient on initial income is insignificant for some specifications if the literacy rate is used to proxy for initial human capital.

[10] However, if one excludes all OECD countries the results are not robust: the regression with the I-variables and the average inflation rate yields an insignificant negative coefficient on initial income.

[11] These results are unchanged with primary school enrollment rates, literacy rates, or the educational attainment levels computed by Psacharopoulos and Arriagada (1986). Also, if one excludes the continent dummies, the extreme bounds procedure still finds that education variables are not robustly correlated

concluding that "the growth rate is substantially positively related to the starting amount of human capital." [Barro, 1991, p.22] Similarly, one should cautiously interpret Barro's (1991) conclusions that lower fertility rates are correlated with faster growth. For some specifications, population growth enters with a significantly negative coefficient, but it enters with a positive but insignificant coefficient with other plausible Z-variables.

The extreme bounds of the I-variables are also computed using the investment share as the dependent variable. As Table 1 illustrates, none of the coefficients are robust. In fact, the coefficient on initial income takes-on both significant positive and negative values. Interestingly, the finding of a non-robust relationship between initial income and the investment share combined with the finding of a robust negative partial correlation between initial income and growth (when controlling for population growth, the investment share, and initial human capital) suggest that per capita income convergence does not operate primarily through increases in domestic savings or international capital flows.

IV. Macroeconomic Variables and Growth

A. Illustrative Overview

This paper's primary aim is to evaluate the degree of confidence one should have in the partial correlations between growth and popular macroeconomic indicators. This introductory subsection uses two relatively comprehensive studies of growth and some simple correlations to illustrate this paper's two major themes: many indicators of policy - taken individually or in groups - are

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with average growth rates.

correlated with growth, but the relationship between any particular indicator or group of indicators and cross-country growth rates is fragile. After this subsection illustrates these findings, the following subsections conduct a systematic series of extreme bounds tests to determine the robustness of past findings.

Tables 2 and 3 anticipate this paper's findings. Country's that grew faster than average over the 1960-89 period tended to have a higher share of exports in GDP, a higher share of investment in GDP, larger primary and secondary school enrollment rates, a lower black market exchange rate premium, and lower inflation rates than slower growing countries. Similarly, Table 3 shows that the investment share, the export share, the black market premium, and the indexes for revolutions/coups and civil liberties are significantly correlated with the average real per capital growth rate. Importantly, however, none of these variables is significantly correlated with the residuals from the regression of growth on the I-variables (the investment share, initial income, initial secondary school enrollment rate, and population growth). Thus, while many policy indicators are significantly related to growth, this relationship depends importantly on what factors are being held constant.

Kormendi and Meguire (1985) and Barro (1991) use a variety of macroeconomic variables to explain growth, and they present intuitively appealing results. Table 4 presents equations based on these studies. Equation 2 is nearly a replication of Barro's (1991) work and includes the share of investment in GDP, a measure of initial human capital, population growth, and initial income along with the ratio of government consumption expenditures to GDP, a dummy variable for socialist economic systems, indicators for revolutions and coups, and dummy variables for Latin America and Africa. Barro's data is

based on Summers and Heston (1988). All variables are of the anticipated sign and initial income, the investment share, primary school enrollment rate, government consumption share, revolution and coups and the continent dummies are significant. Equation 3 is based on Kormendi and Meguire (1985) and includes initial income, the investment to GDP ratio, population growth, the average annual growth rate in the share of government consumption to GDP over the 1960-89 period, the average annual growth rate of domestic credit, the standard deviation of domestic credit growth, the average growth rate in the share of exports to GDP, and a measure of civil liberties. As in Kormendi and Meguire, this equation uses World Bank and IMF data. The coefficients have the anticipated signs and initial income, the investment share, population growth, average growth rate of domestic credit and standard deviation of the growth rate of domestic credit are significant at the 0.05 level. The equations explain 68 and 61 percent respectively of the cross-country variation in growth rates.

Since both equations appear reasonable but include different independent variables, readers may be wary of the findings of each study. To highlight this quandary, we combine the two equations using the union of the two sets of explanatory variables used by Kormendi and Meguire (1985) and Barro (1991). These results are shown in equations 4 and 5, based on World Bank and Summers and Heston data respectively. Only the investment share, initial income, and continent dummies remain significant with both data sets. The standard deviation of domestic credit growth remains significant with World Bank data while the government consumption share and the revolution and coup indicator is significant with the Summers-Heston data. Since the continent dummies simply suggest the importance of omitted variables, the results imply that only the share of investment in GDP and the initial income level - out of the long list

of explanatory variables given in Table 4 - have an independent, statistically significant correlation with cross-country growth differentials computed both from World Bank and Summers and Heston data.

These results suggest that many popular cross-country growth findings are sensitive to the inclusion of explanatory variables. More fundamentally, they illustrate that it is very difficult to isolate a strong empirical relationship between any particular macroeconomic policy indicator and long-run growth. The subsections that follow systematically examine the robustness of fiscal policy, trade policy, monetary policy, and political stability indicators that have been the focus of past studies. In addition, we study international distortion and tax indicators that have not received much attention.

B. Fiscal Policy Indicators

The first variables that we analyze using the extreme bounds procedure are fiscal policy indicators. One of the most important and frequently studied issues in economics is the role of fiscal policy in economic development. Empirical attempts to link aggregate measures of fiscal policy with average per capita growth rates in cross-country studies have tended to use (1) measures of the overall size of the government in the economy; (2) disaggregated measures of government expenditures; or (3) measures of the growth rate of government expenditures. In addition to examining these fiscal indicators, we examine the role of government deficits and disaggregated measures of government taxes.

Before presenting our results, it is worth mentioning some problems with these fiscal policy measures. Governments may provide growth-promoting public goods and design taxes to close the gap between private and social costs. On the other hand, governments may waste funds, funnel resources to endeavors that

do not encourage growth, and impose taxes and regulations that distort private decisions. Aggregate measures of government size will not capture the potentially important implications of how total government expenditures are allocated. Furthermore, even if government funds are always spent on growth-promoting goods, there may be complex, non-linear tradeoffs between the beneficial effects of government services and the deleterious implications of distortionary taxes [see: Barro (1990) and Easterly (1990)].[12] Linear, cross-country regressions will not appropriately capture these relationships. In addition, disaggregated measures of government expenditures and tax sources are only available for a limited number of countries since the 1970s and are particularly prone to measurement problems. Moreover, since government resources may be spent effectively or ineffectively, using simple expenditure data without accounting for government efficiency may yield inaccurate measures of the actual delivery of public services. While recognizing these problems, we focus on examining the robustness of past findings.

A common measure of the role of government in economic activity is the ratio of government consumption expenditures to GDP [e.g., Easterly (1990), Romer (1989), and Landau (1983)]. Table 5-A reports extreme bounds tests of this variable for the period 1960-1989. The coefficient is not robust although the estimated coefficient is always negative.[13]

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[12] See Levine (1991) for an analysis of the effects of different types of taxes on long-run growth.

[13] Similar results were obtained with the Summer-Heston data set, but if the extreme bounds procedure is prohibited from choosing the ratio of government investment expenditures to GDP as a Z-variable, the relationship is robustly negative (with the Summers-Heston data set).

Although subject to data limitations, the ratio of total government expenditures to GDP is perhaps a more complete proxy for the relative size of the government in economic activity than the ratio of government consumption expenditure to GDP. We compute the extreme bounds on the ratio of total government expenditures to GDP for 1974-1989. The partial correlation with the average annual growth rate of per capita GDP is not robust. The sign of the coefficient remains negative but becomes insignificant when other variables are added.

The effect of government expenditures on economic growth, however, may depend on the way in which funds are allocated, not merely total expenditures by the government. Barro (1991) attempts to capture this difference empirically by removing education and defense expenditures from government consumption. In Table 5-A, we provide extreme bounds results using the ratio of government consumption less defense and education expenditures to GDP over the 1974-1989 period during which IMF data is available for a broad range of countries. Barro (1991) finds this measure using Summers and Heston data to be negatively correlated with growth measured over the period 1960-1985. We find that the coefficient on government consumption expenditures less defense and education payments is always negative but becomes insignificant when the standard deviation of domestic credit growth and the Africa dummy are added.[14]

Continuing to examine the effects of the disaggregated components of total government expenditures, we tested in turn the ratios of government capital formation, government education expenditures, and government defense expenditures to GDP. None of these variables were robustly correlated with

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[14] We find that relationship between growth measured over the 1960-1989 period and the government consumption less defense and education indicator measured over the 1974-1989 period is robustly negative as in Barro (1991).

average growth rates in a cross-section of countries. Interestingly, given the strong positive relationship between the share of total investment in GDP and growth, the lack of a robust positive correlation between government investment and growth suggests that the returns are lower to public than private investment.

The central government surplus was used to explore the potential negative effects of government deficits. This variable enters with a positive and robust coefficient when we exclude measures of taxes. When we allowed the extreme bounds procedure to control for the mode of government financing, however, the coefficient on the surplus variable becomes insignificant when the ratio of export tax revenue to exports and the black market exchange rate premium are included as Z-variables.

The growth rate of government expenditures was also tested because Ram (1986) argues that this measure is positively related to growth. An obvious theoretical problem with this is that if government services are a normal good, one would expect growth in government services to parallel income growth. This measure enters with a positive but not a robust coefficient; when the average annual growth rate of exports [studied by Feder (1983)] and the change in exports as a share of GDP [studied by Romer (1989a)] are included, the coefficient on the growth rate of government consumption expenditures becomes insignificant. The high r-square of this equation (.98) suggests that one only need put in the growth rates of enough components of GDP to explain the cross-section variance in growth.

Extreme bounds tests of the ratio of export tax receipts to exports, the ratio of import tax receipts to imports, the ratio of corporate tax receipts to GDP, and the ratio of individual income tax receipts to GDP did not yield any

robust relationships. The coefficient on each of these variable changes sign when the Z-variables are changed.

The second part of Table 5-B presents extreme bounds tests of fiscal indicators with the investment share as the dependent variable. Although many theoretical predictions of a negative relationship between the size of the government and growth are based on a negative impact of government activity on capital accumulation, none of the fiscal policy measures has a robust relationship with the investment share. Indeed, the total expenditure and government consumption measures were actually positively related to the investment share.

In this subsection, we could not find a robust cross-country relationship between a diverse collection of fiscal policy indicators and growth. Specifically, although there are econometric specifications that yield significant coefficient estimates between specific fiscal policy indicators and growth, the coefficients on these same variables become insignificant when the right-hand-side variables are slightly altered. Interestingly, standard fiscal indicators entered with the predicted sign for many econometric specifications when investment was included in the regression but these same indicators were insignificantly related to investment (or they entered with the "wrong" sign). Thus, fiscal policy - to the extent that it has an independent relationship with growth - is correlated with the "efficiency of resource allocation" as opposed to the accumulation of physical capital. These results suggest that the interactions between fiscal policy, investment, and growth may be more complicated than can be captured in simple linear models using fairly aggregate measures of fiscal activity.

C. International Trade and Price Distortions

Over two hundred years ago Adam Smith argued that openness to international markets could enhance productivity by encouraging specialization that would be unprofitable in smaller markets. Recently, this argument and other theoretical ties between trade and growth have been formalized by Rivera-Batiz and Romer (1989), Grossman and Helpman (1989c), and Romer (1986, 1990b). Although theoretical discussions frequently focus on the relationship between international trade and growth, empirical examinations have typically examined the relationship between exports and growth. Consequently, we examine the robustness of export indicators used in past studies. In addition, we examine the relationship between growth and import indicators, total trade indicators, and more direct estimates of trade policy and the distortion between domestic and international prices.

Three important results emerge from these extreme bound tests. First, if one substitutes imports or total trade for exports in cross-country growth or investment regressions one obtains essentially the same coefficient estimate and coefficient standard error.[15] Thus, researchers who identify a significant correlation using an export performance measure should not associate this result with exports per se, because it could be obtained using a corresponding measure of imports or total trade. Second, the share of trade in GDP is robustly positively correlated with the share of investment in GDP.[16] Finally, when controlling for the share of investment in GDP, we could not find a robust

[15] Although this result may not be surprising, it seems to be frequently overlooked as many authors interpret their results as establishing an exclusive relationship between exports and growth.

[16] The black market exchange rate premium is negatively - though not strictly robustly - correlated with the investment share.

independent relationship between any trade or internationa. price distortion indicator and growth.[17] These three results indicate that an important part of the relationship between trade and growth is based on enhanced resource accumulation and not necessarily on the improved allocation of resources.

The major results are in Table 6. Two measures of trade performance that have received considerable attention are the export share of GDP and the growth rate of the export share. The results suggest that there is little link between the export (or import or trade) share and growth once investment is controlled for as none of the coefficients are significant. Measures of export share growth, import share growth, and total trade share growth were tried and also found to be insignificantly related to growth.

Arguing that exports have important externality effects, Feder (1983) uses export growth and export growth times the share of exports in GDP to explain cross-country growth differentials. Table 6-A presents results showing that export growth is not robustly related to growth when government growth variables are included. Similar results hold for exports multiplied by export share or when we substitute imports or total trade for exports. Given the national accounts identity, even if we found a robust relationship, it is not clear what worthwhile inferences could be drawn.

Romer (1990a) finds a strong link between the export share and investment. We confirm this result. The extreme lower bound still indicates a significant, positive correlation between the investment and export shares. The Summers-Heston data set produced similar results. Total trade was also tested and the trade-investment link was still robust. Since outliers may be especially

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[17] Dollar's (1990) measure of the distortion between domestic and foreign prices, however, is negatively - though not strictly robustly - correlated with long-run average growth rates.

important with this measure (i.e. Hong Kong and Singapore have export/GDP ratios greater than one), countries with export shares greater than .75 were dropped. The export share remained robust in explaining investment.[18] The export share was also found to be robust in the growth equation when investment was dropped. These results suggest an important two-link chain between trade and growth through investment. Interestingly, however, the theoretical ties between growth and trade typically seem to run through improved resource allocation and not through a higher investment share.

We also examined more direct measures of trade policy. Leamer (1988) uses the Hecksher-Ohlin-Vanek trade model to construct measures of "openness" and "intervention." The intervention index represents the deviation between the actual and predicted pattern of trade. The openness index represents the difference between the actual and predicted level of trade (as opposed to the pattern of trade). The openness index is constructed so that a higher value represents more "openness."

As Table 6-A indicates, neither Leamer's (1988) intervention or openness indexes is robustly correlated with average long-run growth rates when the I-variables are included in the regression. Both of Leamer's indexes, however, are robustly, positively correlated with the investment share as depicted in Table 6-B. On the one hand this is not surprising because both of Leamer's indexes are highly (e.g., 0.70) and significantly (at the 0.01 level) correlated with the share of trade in GDP, which we found to be significantly correlated with the investment share. On the other hand, these results are difficult to

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[18] When the extreme bounds test is done on the subset of countries for which disaggregated tax data exist (over the 1974-1989 period), the coefficient on the export share becomes insignificant when the ratio of corporate tax receipts to GDP is included.

interpret because the intervention and openness indexes are positively (e.g., 0.63) and significantly (at the 0.01 level) correlated with each other.[19]

We also examine measures of international price distortions. Dollar (1990) constructs an index of the distortion between domestic and international prices (1976-1985) from the Summers and Heston data set. This "real exchange rate distortion" index is significantly positively correlated with the black market exchange rate premium, but it is negatively correlated with the ratio of trade to GDP. These correlations plus the analysis by Pritchett (1990) suggest that one may want to interpret Dollar's (1990) index as a general measure of international distortions and not a narrow measure of trade policy.

Table 6-A shows that Dollar's index is negatively though not robustly correlated with growth when the extreme bounds procedure is allowed to choose the African and Latin American continent dummies and the average fiscal deficit to GDP ratio. If the continent dummies are excluded, however, the partial correlation between growth and the real exchange rate distortion index is negative and robust. But, if one restricts the analysis to countries for which Summers and Heston actually collect price data (the benchmark countries) and excludes those countries for which extrapolation techniques were employed to construct price data, the results are not robust. If one adds the government consumption less defense and education spending to GDP ratio to the I-variables, the coefficient on the distortion index becomes insignificant.

Finally, we examine the average black market exchange rate premium. Since this variable represents the interactions of many policies, it is very difficult

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[19] After carefully examining the relationship between different measures of trade policy, Pritchett (1990) concludes that the "alternative objective summary measures of policy outward orientation produce entirely different country rankings ..." (p. 29) This assessment has obviously dour implications for attempts to quantify the relationship between trade policy and long-run growth.

to interpret this variable as an indicator of any one policy. From Table 6, the black market exchange rate premium is not robustly correlated with growth or the investment share.[20] It does, however, take three additional variables to make the partial correlation of the investment share with the black market premium insignificant. Thus, this conglomerate index of policy distortions does have a generally negative relationship with the investment share.

D. Monetary and Political Indicators

This section examines the empirical relationship between long-run average growth rates and measures of monetary policy and indicators of the political climate. Previous researchers have explored the relationship between measures of monetary policy and growth. Kormendi and Meguire (1985) find that the growth rate of inflation and the standard deviation of money supply shocks are negatively related to growth. Grier and Tullock (1989) find that the standard deviation of inflation is negatively related to growth using a pooled cross-section, time-series analysis. The regression results in Table 4 already suggest that these results are sensitive to the chosen econometric specification. Table 7 indicates that the average growth rate of domestic credit and the standard deviation of inflation are not robustly correlated with growth or the investment share. In fact, the standard deviation of the inflation rate is actually positively related to the investment share for a variety of econometric specification. We also tried inflation and measures of the growth rate of various monetary aggregates and found similarly fragile results. Of course, these measures of monetary policy may be simplistic. Thus,

[20] Similar results were found for just developing countries.

future theoretical and empirical work should focus on deriving empirically testable predictions regarding monetary policy and long-run growth.

The profession has also used a variety of political indicators in searching for explanations of long-run growth. Kormendi and Meguire (1985) find that greater civil liberties are positively related with growth, while Barro (1991) finds that war and revolutions decrease growth. We find (Table 7) that a revolutions and coups index (REVC) and the Gastil index of civil liberties (CIVL) are not robustly correlated with long-run economic growth rates, and the coefficients on these political indicators experienced sign changes when the Z-variables are changed. The revolution and coup indicators, however, is robustly, negatively correlated with the investment share if the extreme bounds procedure is not allowed to include the index of civil liberties (Table 7). Thus, not surprisingly, countries that experience a high number of revolutions and coups tend to be countries that invest less of their resources than countries with stable political environments.

V. Sensitivity of the Sensitivity Analysis and Variable Groupings

The selection of the I-variables was based on theoretical grounds, past empirical findings, and the ability to replicate past finding with this set of included variables. Nonetheless, we examined the robustness of our findings to alterations in the I-variables. We conducted the entire series of extreme bounds procedures with two alternative sets of I-variables. The first set is the original I-variables plus the African and Latin American dummy variables. We add the continent dummies because a number of previous researchers have found significant effects for African and Latin American dummy variables [See Barro (1990, 1991), Romer (1989, 1990a), and Grier and Tullock (1989)]. The second

alternative set of I-variables includes only the investment share because initial income, population growth, and education may be particularly poorly measured. The alternative choices of the I-variables did not alter the results.

In addition, we examined the importance of maximizing the difference in the β_m's rather than the difference in bounds (β_m's plus two coefficient standard errors) to isolate the source of our findings. We found that this alteration in the extreme bounds procedure did not alter the results. This suggests, as does the fact that coefficient standard errors are generally similar between upper and lower bounds, that alterations in the Z-variables change the estimated betas more than the standard errors. Thus, when this procedure identifies a past result as fragile, this is because it finds a different coefficient estimate not a different coefficient standard error.

Finally, we made some attempts to gauge the notion that policies should be interpreted more broadly than any particular measure of fiscal, trade, or monetary performance can capture. For example, the black market exchange rate premium is related to exchange rate policy, monetary policy, trade policy, and political uncertainty, thus it may be "unfair" to include other policy indicators while examining the partial correlation between the black market premium and long-run growth rates. Of course, if a significant coefficient is then found when other policy indicators are excluded, the significance should not be interpreted as representing a correlation between growth and the black market premium per se, but between growth and a general indicator of "distortions." Consequently, we used factor analysis to construct "aggregate policy indicators" from groups of individual policy indicators. For example, we tested the robustness of various "international" distortion indexes, "domestic"

distortion indexes, and "uncertainty" indexes constructed from up to four individual indicators. None were robustly correlated with growth. This again indicates the difficulty of isolating the independent importance of any single policy. National policies appear to be a complex package, and future research may wish to focus on macroeconomic policy regimes as opposed to any particular policy.

VI. Conclusion

Theoretical and empirical research on economic growth suggest a number of channels through which macroeconomic policies may affect long-run growth. We employ a version of Leamer's extreme bounds analysis to test the robustness of a wide assortment of macroeconomic indicators in explaining cross-country growth differentials. We find that very few macroeconomic variables are robustly correlated with cross-country growth rates. We do, however, identify some correlations that are - with some qualifications - robust to slight alterations in the list of independent variables. This will hopefully provide useful information for future theoretical and empirical work.

We briefly summarize our findings:

(1) We found a positive and robust correlation between average growth rates and the average share of investment in GDP.

(2) We found a positive and robust correlation between the share of investment in GDP and the average share of trade in GDP over the 1960-1989 period.

(3) In terms of the convergence hypothesis, we found a negative and robust correlation between the level of initial income and growth when investment and a measure of the initial level of human capital are included and the equation is estimated over the 1960-1989 period.

(4) We found that all findings using the share of exports in GDP could be obtained almost identically using the total trade or import share. Thus, cross-country growth studies that use export indicators should not be interpreted as studying the relationship between growth and exports per se but rather as between growth and trade defined more broadly.

(5) We found that many fiscal indicators are not robustly correlated with growth. Total government expenditures as a fraction of GDP, government consumption expenditures as a share of GDP, government consumption expenditures less defense and education spending as a fraction of GDP, the average growth rate of government expenditures, the growth rate of the share of government expenditures in GDP, and deficits were found not to be robust in explaining growth. Also, disaggregated measures of fiscal expenditures - public investment expenditures, education expenditures, and defense expenditures as a shares of GDP - were not robustly correlated with growth. Similarly, disaggregated tax revenue data - the ratio of export taxes to exports, the ratio of import taxes to imports, the ratios of corporate, individual, and social security taxes in GDP - were not robustly correlated with growth.

(6) A variety of measures of trade - average growth rates, shares of GDP, and average growth rates of shares - were found to not be robustly correlated with growth when the investment share is included.

(7) Finally, a large assortment of other economic and political variables were found not to be robustly correlated with growth including measures of investment in human capital, the average black market exchange rate premium, the standard deviation of the black market premium, the average inflation rate, the standard deviation of the inflation rate, the average

growth rate in domestic credit, the standard deviation in the growth rate of domestic credit, measures of civil liberties, coups, socialist economies, mixed economies, etc. The indicator of revolutions and coups is negatively correlated with the investment share.

Using a linear framework, we have tried to distinguish partial growth correlations that seem robust from those that are fragile. We find that although there are many econometric specification in which macroeconomic policy indicators - taken individually or in groups - are significantly correlated with growth, the cross-country statistical relationship between long-run average growth rates and almost every particular macroeconomic policy indicator are fragile. These results suggest that there is not a strong independent statistical relationship between popular macroeconomic policy indicators and growth even though "policy" defined more broadly is importantly related to growth. Econometrically, this paper highlights the importance of considering alternative specifications in cross-country growth regressions. Finally, we may need to go beyond aggregate macroeconomic indicators in linear cross-country growth regressions to more fully understand economic growth.

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Data Set Variables and Sources

AFRICA	Dummy for Subsaharan Africa
AREA	Land area (000s sq KM) S:WBSI
BMP	Black Market Exchange Rate Premium S:Picks Currency Yearbook, Wood (88), WB updates
BMS	Standard Dev. BMP
CGC (L)	Central Government Gross Capital Formation S:IMFGFS
CIVL	Index of Civil Liberties S:Gastil, Barro
CTX (L)	Ratio Central Govt Corporate Income Tax Revenue to GDP S:IMFGFS
DEE (L)	Ratio Central Govt Defence Expenditure to GDP S:IMFGFS
DEF (L)	Ratio Central Govt Deficit to GDP S:IMFGFS
RERD	Real Exchange Rate Distortion S:Dollar (90), Calculated with SH
RERDB	RERD for SH benchmark countries
EDE (L)	Ratio Government Educational Expenditures to GDP S:IMFGFS
GDC	Growth rate of Domestic Credit S:IMFIFS
GGCFD	Government Capital formation deflated with SH prices S:Barro from IMFGFS, Summers-Heston (88) [SH]
GG	Growth of government consumption expenditures S:WBNA
GM	Growth of imports S:WBNA
GOV	Government Consumption share of GDP S:WBNA
GOVX (L)	Government Consumption less Defense and Education share of GDP GOV - DEE - EDE
GPO	Growth of Population S:WBSI
GR	Growth of real per capita GDP S:SH
GSG	Growth of the Share of Government S:Growth of Share of Government Consumption
GX	Growth of Exports S:WBNA
GYP	Growth of per capita GDP S:WBNA
HSGVX	Share real Government Consumption expenditures minus defense education expenditures S:Barro from SH,IMFGFS
INV	Investment share of GDP S:WBNA
ITX (L)	Share of central govt individual income tax to GDP S:IMFGFS
LAAM	Dummy variable for Latin America

LEAM1	Measure of overall trade openness S:Leamer (88)
LEAM2	Measure of overall trade intervention S:Leamer (88)
LIT	Literacy rate in 1960 S:WBSI
MIX	Dummy variable for mixed government S:Gastil, Barro
MSG	Growth of import share S:WBNA
MTX (L)	Ratio of import taxes to imports S:IMFGFS,IMFIFS
MP	Measure of openness based on import penetration S:Residuals of regres. of M on RGDP60(&sqr),AREA,POP
M	Import share of GDP S:WBNA
OECD	Dummy for OECD
OIL	Dummy for OPEC
PI	Average inflation of GDP deflator S:WBNA
POP70	Population in 1970 S:SH
PRI	Primary enrollment rate 1960 S:Barro from UNESCO,ILO
PRJ	Primary enrollment rate 1970 S:Barro from UNESCO,ILO
REVC	Number of revolution and coups per year S:Barro from Banks
RGDPxx	Real GDP per capita in 19xx S:SH
SCOUT	Dummy for outward orientation based S:Syrquin and Chenery (88)
SEC	Secondary enrollment rate 1960 S:Barro from UNESCO,ILO
SED	Secondary enrollment rate 1970 S:Barro from UNESCO,ILO
SGOV	Real Government Consumption Share S:SH
SINV	Real Investment Share S:SH
SOC	Dummy for socialist economy S:Barro from Gastil
SST (L)	Ratio Social Security taxes to GDP S:IMFGFS
STDD	Standard Deviation of GDC (growth domestic credit) S:IMFIFS
STDI	Standard Deviation of PI (inflation) S:WBNA
TAX (L)	Ratio central government tax revenue to GDP S:IMFGFS
TEX (L)	Ratio total government expenditure to GDP S:IMFGFS
TRD	Ratio total trade (X+M) to GDP S:WBNA
XSG	Growth of export share of GDP

	S:WBNA
XTX (L)	Ratio central govt export tax revenue to exports
	S:IMFGFS
X	Export share of GDP
	S:WBNA
YRSCH	Average years of schooling of labor force @1980
	S:Psacharopoulos and Arriagada (86)

WBNA	World Bank National Accounts Database
WBSI	World Bank Social Indicators
IMF IFS	International Monetary Fund--International Finance Statistics
IMF GFS	International Monetary Fund--Government Finance Statistics

(L) indicates only available for 1974-1989 period

Country List
119 Country Sample

1	AFG	Afghanistan	40	HTI	Haiti	80	PRY	Paraguay
2	DZA	Algeria	41	HND	Honduras	81	PER	Peru
3	AGO	Angola	42	HKG	Hong Kong	82	PHL	Philippine
4	ARG	Argentina	43	ISL	Iceland	83	PRT	Portugal
5	AUS	Australia	44	IND	India	84	RWA	Rwanda
6	AUT	Austria	45	IDN	Indonesia	85	SAU	Saudi Arab
7	BGD	Bangladesh	46	IRN	Iran	86	SEN	Senegal
8	BRB	Barbados	47	IRQ	Iraq	87	SLE	Sierra Leo
9	BEL	Belgium	48	IRL	Ireland	88	SGP	Singapore
10	BOL	Bolivia	49	ISR	Israel	89	SOM	Somalia
11	BWA	Botswana	50	ITA	Italy	90	ZAF	South Afri
12	BRA	Brazil	51	JAM	Jamaica	91	ESP	Spain
13	BDI	Burundi	52	JAP	Japan	92	LKA	Sri Lanka
14	CMR	Cameroon	53	JOR	Jordan	93	SDN	Sudan
15	CAN	Canada	54	KEN	Kenya	94	SWZ	Swaziland
16	CAF	Cent. Afr. Rep	55	KOR	Korea	95	SWE	Sweden
17	TCD	Chad	56	KWT	Kuwait	96	CHE	Switzerlan
18	CHL	Chile	57	LSO	Lesotho	97	SYR	Syria
19	COL	Colombia	58	LBR	Liberia	98	OAN	Taiwan
20	COG	Congo	59	LUX	Luxembourg	99	TZA	Tanzania
21	CRI	Costa Rica	60	MDG	Madagascar	100	THA	Thailand
22	CIV	Cote D'Ivoire	61	MWI	Malawi	101	TGO	Togo
23	CYP	Cyprus	62	MYS	Malaysia	102	TTO	Trin. and
24	DEN	Denmark	63	MLI	Mali	103	TUN	Tunisia
25	DOM	Dominican Rep.	64	MLT	Malta	104	TUR	Turkey
26	ECU	Ecuador	65	MRT	Mauritania	105	UGA	Uganda
27	EGY	Egypt	66	MUS	Mauritius	106	GBR	Great Brit
28	SLV	El Salvador	67	MEX	Mexico	107	USA	United Sta
29	ETH	Ethiopia	68	MAR	Morocco	108	URY	Uruguay
30	FJI	Fiji	69	MOZ	Mozambique	109	VEN	Venezuela
31	FIN	Finland	70	NLD	Netherland	110	YEM	Yemen
32	FRA	France	71	NZL	New Zealan	111	ZAR	Zaire
33	GAB	Gabon	72	NIC	Nicaragua	112	ZMB	Zambia
34	GMB	Gambia	73	NER	Niger	113	ZWE	Zimbabwe
35	DEU	Germany	74	NGA	Nigeria	114	BUR	Burma
36	GHA	Ghana	75	NOR	Norway	115	GUY	Guyana
37	GRC	Greece	76	OMN	Oman	116	BEN	Benin
38	GTM	Guatemala	77	PAK	Pakistan	117	HVO	Burkina Fa
39	GNB	Guinea-Bissau	78	PAN	Panama	118	NPL	Nepal
			79	PNG	Pap. New G	119	SUR	Suriname

TABLE 1

Sensitivity Results for Basic Variables

Non-Oil Countries

Regressions on Growth of Per Capita Income 1960-1989

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.*
Investment Share of GDP (INV)						
High[21]	19.555	2.845	6.87	89	.56	STDI,BMP,GOV
Low	12.762	3.070	4.16	97	.46	XSG,LIT,REVC
Real GDP per capita in 1960 (RGDP60)						
High	-.299	.138	2.16	97	.50	LAAM,XSG,GOV
Low	-.541	.142	3.82	78	.60	GDC,BMP,LIT
Growth in Population (GPO)						
High	-.131	.221	.59	100	.54	X[22],LAAM,PRI
Low	-.546	.234	2.33	90	.56	X,BMP,MIX
Secondary School Enrollment Ratio in 1960 (SEC)						
High	3.708	1.222	3.04	84	.55	X,GOV,GDC
Low	.572	1.208	.47	91	.64	BMP,LAAM,AFRICA

Regression on Investment Share 1960-1989

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.**
Real GDP per capita in 1960 (RGDP60) 1960-1989						
High	.007	.003	2.23	85	.07	GDC,SOC,STDI
Low	-.010	.005	2.15	89	.25	CIVL,BMP,GOV
Growth in Population (GPO) 1960-1989						
High	.006	.007	.82	93	.25	CIVL,LAAM,BMP
Low	-.016	.006	2.65	86	.09	SOC,STDI,GDC
Secondary School Enrollment Ratio in 1960 (SEC) 1960-1989						
High	.059	.042	1.39	84	.15	CIVL,GDC,GOV
Low	-.003	.039	.07	90	.21	BMP,GOV,CIVL

* INV, RGDP60, GPO, and SEC included in all Growth regressions
** no additional variables included in the Investment regressions

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[21]The high beta is the coefficient from regression which obtains the highest beta bound in the extreme bounds analysis. The low beta is from the regression which obtains the lowest beta bound.

[22]The underlined variables show additional variables which make the coefficient of interest insignificant or change sign. In this case the regression of GYP on INV,RGDP,SEC,GPO, and X yields an insignificant coefficient on GPO.

TABLE 2

Cross-Country Averages: 1960-89
(excluding oil countries)

	Fastgrowers	Slowgrowers	t-stat
Share of investment in GDP	0.23	0.17	5.18
Secondary school enrollment rate (1960)	0.30	0.10	5.46
Primary school enrollment rate (1960)	0.90	0.54	6.10
Government consumption/ GDP	0.16	0.12	3.26
Inflation rate	12.34	31.13	-1.74
Black market exchange rate premium	13.57	57.15	-3.79
Share of exports to GDP	0.32	0.23	2.31

Note: Mean growth rate = 1.92
Fastgrowers: Greater than the mean growth rate. (n = 56)
Slowgrowers: Less than the mean growth rate. (n = 53)

TABLE 3

CROSS-COUNTRY CORRELATIONS

	GYP	INV	RES**	X	GOV	PI	BMP	REVC	CIVL
GYP	1.00	0.59*	0.73*	0.32*	0.09	-0.16	-0.38*	-0.36*	-0.41*
INV		1.00	0.00	0.50*	0.28*	-0.04	-0.43*	-0.40*	-0.33*
RES**			1.00	0.09	-0.13	-0.17	-0.13	-0.16	-0.14
X				1.00	0.15	-0.15	-0.22*	-0.34*	-0.23*
GOV					1.00	-0.16	-0.19	-0.29*	-0.19
PI						1.00	0.18	0.46*	0.02
BMP							1.00	0.47*	0.38*
REVC								1.00	0.50*
CIVL									1.000

**RES The residual of the OLS regression of average per capita growth (GYP) on the I-Variables: initial income (RGDP60), population growth (GPO), secondard school enrollment rate (SEC), and the investment share (INV).

* : significantly different from zero at the 0.05 significance level.

TABLE 4

Cross-Country Growth Regressions
Dependent Variable is Average Annual Growth Rate of Per Capita Income

	(1)	(2)	(3)	(4)	(5)
Period	1960-89	1960-85	1960-89	1960-85	1960-85
Data Set	WB	SH	WB	WB	SH
Independent Variables					
Constant	-.83	2.01	.86	.47	2.05
	(.85)	(.83)	(.89)	(1.18)	(1.16)
Initial GDP/Capita	-.35#	-.69#	-.30#	-.40#	-.56#
RGDP60	(.14)	(.12)	(.11)	(.13)	(.13)
Investment Sh.	17.49#	9.31#	16.77#	13.44#	10.32#
INV	(2.68)	(2.08)	(2.62)	(3.13)	(2.50)
Popul. Growth	-.38	.08	-.53#	-.15	-.02
GPO	(.22)	(.18)	(.18)	(.19)	(.19)
Secondary Enroll.	3.17#	1.21		.63	.95
SEC	(1.29)	(1.17)		(1.26)	(1.25)
Primary Enroll.		1.79#		.91	1.02
PRI		(.58)		(.73)	(.70)
Government Share		-6.37#		-.59	-6.75#
GOV		(2.03)		(3.73)	(2.39)
Growth Gov Share			-.08		
GSG			(.06)		
Socialist Econ		-.25		-.21	-.15
SOC		(.38)		(.45)	(.44)
Revolution & Coup		-1.76#		-.86	-1.78#
REVC		(.52)		(.62)	(.60)
Africa Dummy		-1.24#		-1.36#	-1.82#
AFRICA		(.37)		(.48)	(.46)
Latin America Dummy		-1.18#		-1.34#	-1.82#
LAAM		(.33)		(.38)	(.37)
Growth of Dom. Credit			.019#	.013	.008
GDC			(.009)	(.008)	(.007)
Stan. Dev. Dom. Cred.			-.009#	-.006#	-.003
STDD			(.003)	(.003)	(.003)
Export Share Growth			.090	.023	-.027
XSG			(.052)	(.047)	(.046)
Civil Liberties			-.22	.01	.15
CIVL			(.11)	(.13)	(.13)
Number of Obs.	101	103	83	84	84
R^2	.46	.68	.61	.67	.73

#=significant at 5%, Standard errors in parentheses

Regressions 1,3,& 4 use World Bank data for growth and national accounts while numbers 2 & 5 use Summers-Heston (1988) data

TABLE 5-A

Sensitivity Results for Fiscal Variables

Regressions on Growth of Per Capita Income

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.*
Government Consumption Share (GOV) 1960-1989						
High	-1.621	3.355	.48	78	.61	BMP,MIX,AFRICA
Low	-7.189	3.611	1.99	78	.59	LAAM,BMP,GDC
Government Consumption Share minus Def. and Educ. Exp (GOVX) 1974-'989						
High	- 8.648	6.741	1.28	63	.62	STDD,AFRICA,LAAM[23]
Low	-21.024	7.482	2.81	59	.58	BMP,GDC,PI
Total Government Expenditure Share (TEX) 1974-1989						
High	- 2.750	2.055	1.34	67	.54	X,BMP,GDC
Low	- 7.784	2.135	3.65	82	.51	X,MIX,LAAM
Central Government Surplus/Deficit as Share (DEF) 1974-1989						
High	22.495	4.863	4.62	78	.52	AFRICA,X,MIX
Low	13.044	5.584	2.34	65	.57	STDD,BMP,REVC
Low (with tax receipt variables)	5.297	6.181	.86	53	.58	XTX,BMP,MTX
Growth of Government Consumption Spending (GG) 1960-1989						
High	.271	.054	5.01	89	.66	REVC,BMP,GOV
Low(exXG)	.106	.052	2.03	85	.64	GDC,STDD,X
Low(inXG)	.017	.012	1.41	95	.98	XG,XSG,GOV

* INV, RGDP, GPO, and SEC included in all Growth regressions.

Underlined variables show additions which make coefficient insig. or change signs

[23] If one excludes the continent dummies, the extreme bound procedure chooses X, BMS, STDD as Z-variables. This yields a coefficient on GOVX of -13.5 and a t-statistics of 1.81, which is not significant at the 0.05 level.

TABLE 5-B

Sensitivity Results for Fiscal Variables

Regressions on Investment Share

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.**
Government Consumption Share (GOV) 1960-1989						
High	.309	.114	2.71	101	.09	LAAM,MIX,STDI
Low	.083	.110	.76	78	.36	X,BMP,GDC
Government Consumption Share (GOVX) 1974-1989						
High	-.004	.175	.03	75	.09	AFRICA,LAAM,CIVL[24]
Low	-.616	.203	3.03	59	.18	BMP,GDC,CIVL
Total Government Expenditure Share (TEX) 1974-1989						
High	.119	.056	2.14	86	.08	CIVL,SOC,MIX
Low	.039	.052	.74	85	.20	X,AFRICA,LAAM
Central Government Surplus/Deficit as Share (DEF) 1974-1989						
High	.050	.165	.31	74	.08	AFRICA,MIX,BMP
Low	-.067	.191	.35	65	.04	STDI,BMP,GDC

** no additional variables included in the Investment regressions

Underlined variables show additions which make coefficient insignificant or change signs

[24] If one does not allow the extreme bounds procedure to choose the continent dummies, the coefficient on GOVX becomes insignificant with the inclusion of STDI.

TABLE 6-A

Sensitivity Results for Trade Variables

Regressions on Growth of Per Capita Income

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.*
Exports as percentage of GDP (X) 1960-1989						
High	1.3549	.7782	1.74	97	.55	GOV,AFRICA
Low	- .2641	.9659	.27	79	.59	PI,GDC,BMP
Imports as percentage of GDP (M) 1960-1989						
High	1.6395	.8982	1.83	95	.53	GOV,AFRICA
Low	-1.8000	1.0722	1.68	78	.58	PI,GDC,BMP
Growth of Exports (avg. annual) (GX) 1960-1989						
High	.2517	.0349	7.21	96	.71	AREA,REVC,GOV
Low (exGG)	.2141	.0381	5.62	78	.71	GOV,GDC,BMP
Low (inGG)	.0085	.0103	.83	86	.98	GSG,GG,STDD
Growth of Imports (avg. annual) (GM) 1960-1989						
High	.2845	.0424	6.71	95	.69	GOV,LAAM,GSG
Low (exGG)	.1940	.0454	4.27	86	.71	STDD,LAAM,AFRICA
Low (inGG)	.0137	.0184	.74	87	.97	GSG,GG,BMP
Openness measure based on factor adjusted trade-Leamer (LEAM1) 1974-1989						
High	-.8478	1.5798	.54	49	.58	AFRICA,LAAM,PI
Low	-3.3110	1.4062	2.35	38	.74	AFRICA,LAAM,GOVX
Trade Distortion based on H-O deviations-Leamer (LEAM2) 1974-1989						
High	.5659	1.8665	.30	49	.58	AFRICA,LAAM,PI
Low	-5.8597	2.1404	2.74	38	.63	AFRICA,BMS,DEE
Black Market Exchange Rate Premium (BMP) 1960-1989						
High	-.0014	.0026	.53	91	.58	PI,SOC,MIX
Low	-.0053	.0030	1.78	79	.59	LAAM,REVC,GDC
Real Exchange Rate Distortion-Dollar (RERD) 1974-1989						
High(wdum)	-.0059	.0057	1.04	81	.66	AFRICA,LAAM,DEF
High	-.0167	.0069	2.42	64	.55	GOVX,PI,STDD
Low	-.0227	.0071	3.18	74	.44	PI,STDI,DEE

*INV, RGDP, GPO, and SEC included in all Growth regressions

Underlined variables show additions which make coefficient insig. or change signs

TABLE 6-B

Sensitivity Results for Trade Variables

Regressions on Investment Share

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.**
Exports as percentage of GDP (X)						
High	.1600	.0298	5.31	86	.26	GDC,STDI
Low	.0951	.0244	3.90	100	.35	GOV,REVC,STDI
Openness measure based on factor adjusted trade-Leamer (LEAM1) 1974-1989						
High	.152	.053	2.89	47	.18	LAAM,STDI,GDC
Low	.104	.049	2.11	47	.30	AFRICA,REVC,GDC
Trade Distortion based on H-O deviations-Leamer (LEAM2) 1974-1989						
High	.240	.044	5.44	47	.42	LAAM,GDC,CIVL
Low	.177	.038	4.60	49	.55	AFRICA,CIVL,REVC
Black Market Exchange Rate Premium (BMP) 1960-1989						
High	-.00020	.0001	1.58	78	.19	GDC,GOV,REVC
Low	-.00042	.0001	3.98	81	.21	LAAM,MIX,STDD
Real Exchange Rate Distortion-Dollar (RERD) 1974-1989						
High	-.0000	.0002	.01	64	.25	AFRICA,GDC,GOVX
Low	-.0005	.0002	2.85	91	.11	LAAM,MIX,GDC

** no additional variables included in the Investment regressions

Underlined variables show additions which make coefficient insig. or change signs

TABLE 7

Sensitivity Results for Monetary, Exchange Rate, and Political Variables

Regressions on Growth of Per Capita Income 1960-1989

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.*
Growth of Domestic Credit (GDC)						
High	.0011	.0061	.18	85	.66	LAAM,MIX,AFRICA
Low	-.0054	.0065	.83	85	.57	X,SOC
Standard Deviation of the Rate of Inflation (STDI)						
High	-.00027	.0007	.37	101	.49	LAAM,REVC,MIX
Low	-.00124	.0007	1.84	85	.59	GDC,CIVL,REVC
Revolution and Coups (REVC)						
High	.6391	.7699	.83	79	.60	GDC,BMP,PI
Low	-1.4701	.6371	2.31	101	.52	AFRICA
Civil Liberties (higher=less CIVL)						
High	.1043	.1458	.72	79	.63	GDC,BMP,AFRICA
Low	-.3491	.1268	2.75	101	.52	MIX,LAAM

*INV, RGDP, GPO, and SEC included in all Growth regressions

Sensitivity Results for Monetary, Exchange Rate, and Political Variables

Regression on Investment Share 1960-1989

	Beta	Stan.Err.	T-Stat	N	R^2	Other Incl. Vars.
Growth of Domestic Credit (GDC) 1960-1989						
High	.00041	.0003	1.54	85	.18	CIVL,REVC,SOC
Low	.00003	.0003	.10	86	.03	SOC,MIX
Standard Deviation of the Rate of Inflation (STDI) 1960-1989						
High	.00006	.00002	2.57	92	.32	REVC,LAAM,BMP
Low	-.00001	.00002	.55	105	.08	AFRICA,SOC,MIX
Revolution and Coups (REVC) 1960-1989						
High	-.0347	.0228	1.52	88	.34	X,CIVL,STDD[25]
Low	-.0880	.0241	3.65	85	.17	SOC,MIX,GDC
Civil Liberties (higher=less CIVL) 1960-1989						
High	.0029	.0041	.70	85	.27	REVC,AFRICA,GDC
Low	-.0108	.0032	3.38	88	.15	SOC,MIX,STDD

[25] If the extreme bounds procedure is not allowed to choose CIVL, the coefficient on REVC is robustly negative even when the procedure is allowed to choose continent dummies.

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