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Is Growth Enough?
Macroeconomic Policy and
Poverty Reduction

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Abstract

The paper investigates the existence of "super pro-poor" policies—that is, policies that directly influence the income of the poor after accounting for the effect of growth. It uses a dynamic panel estimator to capture both across- and within-country effects, and a Bayesian-type robustness check to account for model uncertainty. The findings confirm that growth raises the income of the poor, although this relationship is less than one-to-one. The analysis also identifies four super pro-poor conditions that are influenced by policy: inflation, government size, educational achievement, and financial development.

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I. INTRODUCTION

1.   The renewed sense of urgency for faster and deeper poverty reduction has spawned a growing debate on the determinants of poverty and the strategies for poverty reduction. Recent issues of the World Bank's *World Development Report* (most notably the editions for 1990 and 2000) have focused on poverty reduction, and the United Nations Development Program's *Human Development Report* started publishing an annual index on human development in 1990. In the academic literature, a key point of reference has been the impact on poverty reduction of periods of rapid economic growth in East Asia, with empirical research generally stressing the primacy of improvements in average income as a source of reductions in poverty.

2.   Nonetheless, while much research has been undertaken on the role of economic growth in lowering poverty, little is known about the set of economic policies that have an additional impact (other than through growth) on poverty reduction. The current paper contributes to the ongoing empirical literature on avenues to lower poverty. This paper provides an estimate of the elasticity of the income of the poor with respect to average income, as well as evidence on the set of "super pro-poor" policies that directly influence the income of the poor, after controlling for the effect of economic growth. The investigation herein considers a large set of policy variables and explicitly accounts for model uncertainty by means of a formal robustness check.

3.   The empirical findings suggest that economic growth raises the income of the poor, although by less than one-to-one. This implies that, for a given target of poverty reduction over a certain period of time, the economic growth rates required may exceed what can be reasonably expected (compared with what would be required if an increase in economic growth resulted in a one-to-one or higher increase in the income of the poor). This also implies that there is a role for policies that take into account the distributional impact of economic growth. An interesting finding of this paper is that certain policies can have direct impact on the income of the poor, even after controlling for the effect of economic growth. These include policies that lower inflation, shrink government, promote financial development, and raise educational achievements. The policy-related variables are considered "super pro-poor" in the sense that they raise the income of the poor directly, as well as through the economic growth channel. The direct and indirect effects are mutually reinforcing, and thus there are no identified trade-offs between growth promotion and poverty alleviation. The results on the impact of policy-related variables on poverty stand in contrast to previous studies,[2] which find that once the effect of overall income has been taken into account, there exist no such super pro-poor policies; instead, these results confirm the findings of Collier and Dollar (2001) that the policy environment has a direct impact on poverty reduction. At the same time, the result on the impact of inflation confirms that of Easterly and Fischer (2001), who find that direct measures of the well-being of the poor are negatively correlated with inflation.

4.   After a brief review of the literature and the data, the paper discusses the theoretical and econometric framework, presents the econometric results, and finally, discusses the policy implications.

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[2] See, for example, Dollar and Kraay (2001) and Roemer and Gugerty (1997).

II. LITERATURE REVIEW

5.   Empirical research has served to highlight how little is still known about the dynamics and causes of changes in income distribution. The current view is that (i) growth does not consistently affect inequality one way or the other (the Kuznets hypothesis having essentially been refuted by panel studies), and (ii) the initial level of inequality does appear to have a negative impact on subsequent growth. For the first proposition, Deiniger and Squire (1998) and Ravallion and Chen (1997) provide key evidence, leading Kanbur and Squire (2001, p. 192) to conclude that "...inequality and income are not systematically related according to some immutable law of development." The policy-relevant conclusion is that researchers should identify "policies, or combinations of policies, which will generate growth without adverse distributional effects, rather than rely on the existence of an aggregative, reduced form, relationship between per capita income and inequality" (Kanbur, 2000, p. 812).

6.   On the second proposition, Bourguignon and Morrisson (1990) find that concentration in land ownership is closely associated with cross-country measures of inequality, and Deininger and Squire (1998) suggest that land ownership concentration, perhaps proxying for wealth distribution, reduces subsequent growth. Deininger and Olinto (2000) confirm the negative impact of asset, but not income, inequality on subsequent growth, and in addition, suggest that unequal distribution of assets may reduce the effectiveness of education.

7.   Focusing specifically on the more vulnerable groups, Dollar and Kraay (2001; hereinafter referred to as "DK") suggest that the income of the poorest one-fifth of the population grows in direct proportion to average income or, equivalently, that there is no correlation between growth in average income and changes in inequality.[3] In addition to a timely reaffirmation of the conclusion that growth tends to be distributionally neutral and to reduce the *absolute* level of poverty, DK also find that economic policy (other than through its role in the growth process) has no impact on the share of the income of the poor.[4] Low inflation, which Easterly and Fischer (2001) suggest does have a separate impact on poverty rates, is found by DK to be, at best, marginally significant.

8.   Roemer and Gugerty (1997) report a relationship between the income of the poor and average income that is less than one-to-one when the poor, as in DK, are defined as the bottom 20 percent of the income distribution, and exactly one-to-one when the poor are defined as the bottom 40 percent of the distribution.[5] In addition, Roemer and Gugerty (1997) find that the

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[3] The latter version of this proposition has been in the literature for some time; see Bruno, Ravallion, and Squire (1998) for a useful survey.

[4] For the debate on the impact of data quality, see Ravallion (2001) and the references therein.

[5] This investigation did consider the relationship between different segments of the income distribution and average income with no discernible differences found. Only the results for the bottom 20 percent are discussed below.

degree of openness of the economy does not have an independent effect on the income of the poor once the effect of overall income has been taken into account.

9.   In investigating the connection between economic growth and *human development*, Moser and Ichida (2001) utilize the framework advanced by Ranis, Stewart, and Ramirez (2000).[6] Measuring human development on the basis of (average) life expectancy, infant mortality rates and primary school enrollment, Moser and Ichida (2001) report that, for sub-Saharan Africa, the average income of a country is significantly and positively associated with progress on the human development front—similar to the findings in Ranis, Stewart, and Ramirez (2000), Anand (1991), and Anand and Ravallion (1993).[7] Additionally, similar to DK, Moser and Ichida (2001) find that macroeconomic policy does not affect human development other than through its impact on economic growth.

10.   Anand and Ravallion (1993) find that, in explaining variations in life expectancy, average income loses its statistical significance once an index of poverty and the level of public health spending per person have been added as explanatory variables. In a complementary exercise, Gupta, Verhoeven, and Tiongson (2001), on the basis of survey data and dividing the sample into poor and nonpoor, suggest that public spending on health care does affect the health status of the poor, even after controlling for mean consumption (which is itself insignificant). It bears emphasizing that none of these results imply that economic growth is not a factor in human development. Instead, as Anand and Sen (2000, p. 2033) mention: "what they indicate is that the connections are *contingent*, and much depends on how the fruits of economic growth are shared … and how far the additional resources are used to support public services…."

11.   To summarize, the existing empirical evidence on poverty reduction and, more broadly, on human development strongly supports the primacy of the role of economic growth. Given that income distribution does not appear to undergo substantial changes during the process of economic development, this is an unsurprising conclusion. In terms of delineating a more complete poverty reduction strategy, the key question centers on the particular set of policies that can stimulate deeper and faster poverty reduction. As discussed above, existing evidence suggests that there are no super pro-poor policies at the macroeconomic level. Should this assertion hold up, the immediate implication would be that the only necessary macroeconomic input to an effective poverty reduction strategy is growth promotion.

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[6] There is, of course, a long history to the debate on the relationship between economic and human development. For example, Anand and Sen (2000, p. 2031) quote Aristotle as favoring human development: "wealth is evidently not the good we are seeking, for it is merely useful and for the sake of something else." More recently, Sen (1980) proposes the concept of expanding human capability as the objective of human economic activity.

[7] Earlier evidence suggests that, at the aggregate level, the many aspects of poverty (including education and health) are highly correlated, or, as stated by Kanbur and Squire (2001, p.184), "…broadening the definition of poverty does not change significantly who is counted as poor."

III. DATA

A. Definitions and Sources

12.   To focus the discussion on the determinants of poverty rates, the set of possible determinants of poverty is divided into the following broad categories:

- internal environment or resources (including natural resources and ethnicity);
- institutions / governance (including rule of law and level of democracy);
- human capital (including educational outcomes and life expectancy);
- physical capital (including private and public investment);
- macroeconomic stability (including inflation and fiscal balance);
- government size (ratio of government consumption to GDP);
- trade regime (including share of exports and imports in GDP);
- external environment (including changes in terms of trade); and
- financial development (including the ratio of broad money to GDP).

Table A1 in Appendix details, for each category, the component variables and their sources.

13.   Additionally, it turns out to be useful to rank the 85 countries for which data were available according to the level of income of the poor. As shown in Appendix Tables A2 and A3, countries are grouped into four groups based on the distance from the overall mean of the income of the poor. The countries farther above the sample mean of income of the poor (essentially the OECD countries) are denoted as "High," while at the other extreme, the countries farther below the sample mean are denoted as "Very low." In between these extremes, there are 'Medium' and "Low" countries which are, respectively, just above and below the sample mean.

14.   The data on inequality and income of the poor (defined as the income of the lowest quintile of the income distribution) are taken from DK, which contains a lengthy discussion on the sources and quality of the data. To ensure consistency, additions to the set of explanatory variables follow procedures similar to DK to arrive at an unbalanced, irregularly spaced panel set of observations covering 137 countries over the period 1950-99. For each country, the data set includes observations that are at least five years apart, yielding a maximum of 418 country-year observations. After filtering out countries with less than two observations, in order to enable examination of within-country changes, the sample size is reduced to 285 observations. For purposes of estimation, differences in data availability across countries and variables translate into further reductions in sample size for different combinations of explanatory variables.

B. Correlates of Poverty Rates

15.   For an initial snapshot of the determinants of poverty, data summaries, for the period 1960 to 1999, by country group are presented in both tabular (Appendix Table A2) and graphical form (Figures Appendix Figures A1-A6). In addition to higher income on average, countries with higher income of the poor tend to have generally better indices of institutional development and policy implementation, including the following:

- lower levels of income inequality;
- better internal environments;
- more democratic political institutions and improved governance;
- higher levels of human capital;
- more open trade regimes; and
- higher levels of financial development.

16.   Higher income of the poor does tend to be associated with more macroeconomic stability, as measured by lower levels of inflation and a stronger government fiscal balance as a ratio to GDP. As regards government size, the positive relationship with respect to government consumption, as shown in Appendix Table A2 and Appendix Figure A5, suggests that governments may be able to spend their way to less poverty. An examination of the apparent paradox by country group begins to dispel the notion by revealing interesting non-linearities, as shown in the table below.

Country Group	Correlation Coefficient 1/
High income	+0.43
Medium income	-0.38
Low income	-0.04
Very low income 　　All inclusive 　　Excluding Madagascar and Sierra Leone	 -0.22 -0.59
Sources: See Appendix A1-A3 for data; and authors' calculations.	
1/ Simple correlation between government consumption and income of the poor.	

17.   It would thus appear that the overall positive correlation depends largely on the subgroup of "High" countries—perhaps a manifestation of the Wagner hypothesis on the relationship between the level of development and size of government. Moreover, a simple Ordinary Least Squares (OLS) regression indicates that the overall positive effect tends to abate once other country characteristics are taken into account. In fact, regressing the income of the poor on government consumption while setting an additional control for average income immediately reduces the slope of government consumption to statistical insignificance. On physical capital, the mixed nature of the evidence involves differences in patterns based on the source of the investment. Thus, private investment is found to be inversely related to poverty while the converse is true for public investment.

18.   An examination of the best- and worst-performing countries with respect to levels of poverty yields similar correlations at the country level. For example, the three lowest-ranked countries in the sample—Mali, Tanzania, and Sierra Leone—tend to rank in the lower half of both institutional development and policy implementation. The depth of poverty is particularly well illustrated by their extremely low ranking in terms of educational outcomes and life expectancy, consistent with the observation that widening the definition of poverty does not tend to change who is considered as poor. The tendencies are preserved if, instead, the highest-ranked countries, (in this case, Luxembourg, Belgium, and Canada) are examined; that is, these

countries rank higher in terms of low poverty and with respect to the other development dimensions.

19.   It is informative to compare changes in correlation coefficients across groups to identify variables with a significant association with poverty rates. Here, a variable is defined as having a significant impact on poverty rates if the change in the correlation coefficient across groups is statistically significant. This analysis suggests that in order to reduce poverty at a rate consistent with a move from either "Low" to "High" or "Very low" to "High," countries must improve along a broad set of dimensions, namely income inequality, population growth rates, rule of law, level of education, terms of trade, and financial development. A lower levels of ethnic heterogeneity is also (weakly) associated with lower rates of poverty.

IV. POVERTY, GROWTH, AND MACROECONOMIC POLICY

20.   Current theories on income distribution provide little in the way of policy-relevant insights, and Srinivasan (2001, p. 4) cautions that "there are in theory no 'deep' (in the Lucas sense) parameters to be found empirically in the data, inexorably linking growth with [poverty and inequality]."[8] The focus of this paper is therefore on an empirically driven search for poor-friendly policies; deriving a grand theory linking poverty, growth, and inequality remains for another day. This section provides a description of the theoretical framework, followed by a brief discussion on the determinants of poverty rates.

A. Theoretical Framework

21.   In estimating the effect of economic growth on the incomes of the poor and searching for super pro-poor policies, policymakers must confront the possibility that public policy in this area may involve significant trade-offs with respect to the twin goals of growth promotion and poverty reduction. For example, one criticism of a strict focus on growth promotion as a poverty reduction strategy suggests that the benefits of growth tend to reach the poor only long lags. The

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[8] In the absence of a unified theory on growth and distribution, current theoretical models (necessarily) focus on one particular transmission channel, thereby greatly increasing the ex ante set of possible determinants. For example, Durlauf and Quah (1999) find that in excess of 90 different variables have been proposed as determinants of growth, while there are only 120 countries over which observations can be gathered. A (more) unified theory would, for example, say something about the effect of both inequality and trade policy on growth and might even rule one of these out as a determinant of growth. Additionally, predictions from existing theory are just as ambiguous as those from empirical evidence in suggesting that higher inequality may be associated with either faster or slower growth. For a good overview, see Bertola (1998), and for a recent empirical exercise suggesting that higher inequality may actually foster growth, at least over short-run periods, see Forbes (2000).

ensuing policy advice is that, notwithstanding the negative impact on growth, the government should intervene directly in improving the lives of the poor.[9]

22. A natural setup to investigate the competing claims on the importance of growth for poverty reduction is to regress the logarithm of per capita income of the poor, y^P, on the logarithm of average per capita income, y:

$$y_{ct}^p = \beta + \beta_1 \cdot y_{ct} + \beta_2 \cdot G_{ct} + \beta_3 ' \mathbf{Z}_{ct} + \eta_c + \gamma_t + v_{ct}, \tag{1}$$

where c and t index countries and years, respectively; G is the Gini coefficient; $\mathbf{Z}_{ct}$ is a vector of other determinants of mean income of the poor; and $\eta_c + \gamma_t + v_{ct}$ is a composite error term including unobserved country effects. The coefficient on average income provides an estimate of the effect of economic growth, while the coefficients on $\mathbf{Z}_{ct}$ identify factors that have a direct impact on poverty rates. The inclusion of a separate control for distributional changes, G, is in accordance with the literature on the joint determination of growth, income, and poverty. Consequently, the inclusion of initial values of the Gini coefficient allows for a test on the effect of initial inequality on the rates of poverty, similar to the proposal in the literature on growth and inequality that initial levels of inequality may affect the subsequent evolution of average income.

23. To the extent that, following the literature on growth and distribution, the poor are defined as those who live below an absolute poverty line (for example, less than US$1 per day for abject poverty), the implication of $\beta_1=1$ (as in DK), is that growth promotion, by itself, will eventually eliminate poverty. In this sense, growth promotion is sufficient for poverty alleviation. A statistically significant value of $\beta_1 < 1$ would also indicate that growth is beneficial for poverty reduction, but, for a given level of poverty reduction, its impact would take longer to materialize (than for a value of $\beta_1=1$). In the case of $\mathbf{Z}_{ct}$, nonzero coefficients identify policies (or exogenous conditions) that are either super pro-poor or that involve trade-offs between growth promotion and poverty alleviation.

24. In terms of policy evaluation, a crucial question immediately arises: How robust is the DK conclusion on the lack of a direct impact for macroeconomic policy on poverty? In terms of equation (1), is β_3 ever statistically significant? To provide a comprehensive answer to this question, this paper expands the set of $\mathbf{Z}_{ct}$ regressors (even including some exogenous environment variables, such as terms of trade, which are nonetheless of interest), and tests for specification robustness, as suggested by the literature on Bayesian model averaging and applied, in the context of growth, by Doppelhofer, Miller, and Sala-í-Martin (2000).

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[9] In practice, improvements in the provision of basic services, including by reallocation of government expenditures, are standard prescription for economic growth, and progress on the human development front (as measured by health and educational indices) tends to occur alongside increases in growth rates. The same tends to be true in reverse: when the economic growth environment reduces the rate of return for skills acquisition, the incentive to acquire those skills will be reduced, even if public monies are shoveled into educational facilities.

B. Determinants of Poverty Rates

25.   The standard set of growth-stimulating policies—such as trade openness, institution building, and prudent fiscal and monetary stances—increases the opportunity set of profitable investments, benefiting the poor primarily by an expansion of the opportunities to earn a return from labor employment. For example, trade restrictions that tend to protect capital-intensive importables reduce the returns to labor, and overvalued exchange rates that reduce the profitability of tradables turn the terms of trade against the poor, who tend to be net producers of tradables.[10] Additionally, environmental influences, like the availability of arable land and reliance on natural resources, and external factors, such as changes in the terms of trade, together with institutional characteristics, such as the level of democracy, may plausibly have dissimilar impacts on different segments of the income distribution. This section expands the discussion in the literature review to cover poverty determinants other than economic growth. With respect to growth-related policies, this discussion focuses on the direct links to the income of the poor, abstracting, for the most part, from discussing the growth implications. For an excellent summary of the latter, see Durlauf and Quah (1999).

Macroeconomic stability

26.   The impact of macroeconomic stability is captured by inflation and the government budget balance relative to GDP. A stable macroeconomic environment—characterized by low and predictable inflation, sustainable budget deficits, and limited departure of the real exchange rate from its equilibrium level—sends signals to the private sector about the commitment and credibility of a country's authorities to efficiently manage their economy. In addition to the beneficial effects on growth, investment, and productivity (see, for example, Easterly and Kraay, (1999); and Fischer (1993)), some studies have identified an adverse impact of inflation on the poor (e.g., Easterly and Fisher (2002)). Using survey data from a cross section of countries, Easterly and Fischer (2001) find that the poor are more likely than the rich to mention inflation as a top national concern. Furthermore, using pooled time-series and cross-country data, these authors find that direct measures of the well-being of the poor (e.g., the change in their share of national income and the real minimum wage) are negatively correlated with inflation. Some of the arguments that have been advanced include the fact that the rich are more likely to have access to financial hedging instruments that can be used to protect the real value of their wealth.

Inequality

27.   Trivially, progress in reducing rates of poverty through economic growth depends crucially on its distributional characteristics. This is particularly true for statistical measures of poverty as relatively large numbers of people are clustered around typical poverty lines. As a

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[10] Additionally, it is possible that policies such as trade openness affect human development more favorably in certain circumstances, for example, in a context of wider civil or economic freedom. Perhaps through improved equality of opportunity (either social mobility or degree of structural flexibility), a society characterized by a higher degree of economic freedom may allow its members faster access to the benefits of global competition.

corollary, the poverty gap[11] in the developing world is surprisingly small, at about one-third of total consumption by the developing world in 1985 for the poorest one-fifth of the population in the developing world. While these characteristics do raise the prospects for poverty alleviation through growth, as in East Asia in the 1960s, 1970s, 1980s, and most of the 1990s, Lipton and Ravallion (1995, p. 2585) point out that "only small deviations in neutrality" are necessary to reverse the poverty-reducing effects of distributionally neutral economic growth. This study measures inequality with the Gini index of inequality.

Natural resources and labor productivity in agriculture

28. It is likely that the source of the economic growth—for example dependence on natural resources—matters for inequality, poverty and human development. Lewis (1954), for instance, attributes the onset of growth to higher income in an enclave sector characterized by higher productivity of labor. Suppose, for example, that the sector initially more productive is either an oil- or mineral-extractive industry. Leite and Weidmann (1999) link economic dependence on oil and mineral resource sectors to the availability of appropriable rents, the higher incidence of corruption, and, subsequently, lower economic growth. Appropriation of such rents by a section of the population, say, the elite, would be expected to delay the propagation of economic development to the remainder of the economy (by reducing the level of investment in the nonresource sector), and to both widen the level of inequality and reduce the level of human development in the intervening period.

29. Returns that accrue initially to a wider set of agents, such as the case of a highly productive agricultural sector, may allow for more progress with respect to poverty alleviation. Ravallion and Datt (1996) find that the aggregate time-series data for India indicate that poverty measures have responded far more to rural economic growth than urban economic growth. For East Asia, some of the credit for the growth with equity experience is typically ascribed to the strong performance in the agricultural sector. Intuitively, it is likely that those poor economies with better-functioning credit and land markets, and with a distribution and system of landholding consistent with market incentives, are more likely to perform better in the area of poverty reduction. Given that a majority of poor people are in the agricultural (rural) sector, this study also measures the impact of the sectoral distribution of growth by the relative productivity performance of the agricultural sector.

Institutions and governance

30. The distribution, across income groups, of the benefits of growth is likely to depend not just on the sectoral pattern of growth but also on the degree of popular representation at the

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[11] As detailed in Lipton and Ravallion (1995), the poverty gap index (PG) reflects the depth of poverty by taking into account (i) the number of poor, and (ii) how far the poor are below the poverty line. Policy-wise, PG indicates the "potential for eliminating poverty by targeting transfers to the poor" (p. 2579). Technically, $PG = 1 - y/z$, where y is the level of income and z is the poverty line.

policymaking level, as well as the effectiveness of the governing institutions. Whereas economic freedom may herald stronger property rights and freer markets and, therefore affect the income of the poor mainly through its beneficial impact on overall economic performance, political emancipation may be associated with the tendency to enact income redistribution schemes (including land reforms), and it may shift the focus of economic policy toward equity, possibly at the expense of (some) economic growth. Through its likely positive impact on other variables (for example, the rule of law and the rate of investment), democracy's main impact on the income of the poor (and on overall income) may also be indirect. Barro (1996) discusses the impact of the rule of law and free markets on economic growth, while Easterly and Levine (1997) provide an interesting evaluation of the role of institutions and economic policies in economic growth in Africa.

Human development

31.   Given a conducive environment, the productivity of the labor supplied by the poor is an important determinant of their ability to benefit from the enhanced opportunities—a situation that points to important synergies between growth promotion and initial conditions. Recent work in development economics acknowledges that a fundamental reason for the success of East Asia in promoting equitable growth was due not only to the labor-demanding nature of production but also to the relatively large stock of education and skills embodied in the labor force. This study captures the effect of human capital development through measures of health and educational status (such as life expectancy and school enrollment rates). In the case of educational status, these result-oriented measures also capture the effects of local incentives to acquire the related skills (more so than public expenditure data).

Financial sector development

32.   Financial sector development may also benefit the poor by facilitating access to credit and improving risk sharing and resource allocation. The poor, owing to their lack of assets and the general unacceptability of labor income as collateral, tend to have more difficulties than the rich in accessing credit. In particular, this prevents the poor from (i) smoothing their consumption in bad times; and (ii) investing in riskier but more productive technologies (for which effective risk sharing is necessary). Observationally, two phenomena are likely to arise: (i) underinvestment by the poor will tend to be particularly large with respect to education, and (ii) a positive correlation between the distribution of resource levels and investment opportunities will tend to widen inequality. In both cases, there is the potential for significant policy complementarities between access to credit (with which to invest in education) and the increase in the returns to labor occasioned by growth promotion policies. In this study, financial sector development is measured by the ratio of broad money to GDP.

Physical capital

33.   Empirical studies consistently report a positive role for the investment ratio in explaining international differences in both the standard of living (as measured by GDP per capita) and economic growth rates—see Mankiw, Romer, and Weil (1992). A number of studies have also investigated the possibility that the public and private components of investment have different

impacts on economic growth—for example, Ghura and Hadjimichael (1996)—and that both components tend to be growth promoting. With respect to the income of the poor, both public and private investment would be expected to influence it. Public investment in basic infrastructure benefits the poor by facilitating initial access to markets or to basic social services. To the extent that the productivity of private investment is enhanced, the impact on the poor would be further strengthened.[12]

V. ECONOMETRIC METHODOLOGY

34.   The study of socioeconomic phenomena is typically plagued by inconsistent empirical estimates and model uncertainty.[13] The first case typically arises with the omission of country specific effects, which, if not uncorrelated with other regressors, leads to a misspecification of the underlying dynamic structure, or with the incorrect treatment of endogenous variables as exogenous variables. To simultaneously address both omitted variable bias and issues of endogeneity, this paper follows DK in using panel data (to capture information from both cross-section and time-series data), and in employing a systems generalized method of moments (GMM) estimator (which uses information from both a levels and a differences equation).[14]

35.   Model uncertainty arises because the lack of clear theoretical guidance on the choice of regressors results in a wide set of possible specifications and, often, contradictory conclusions. The analyst has three options: (i) arbitrarily select one model as the true model generating the data; (ii) present the results based on all plausible models without selecting one of the different

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[12] As stated in Lipton and Ravallion (1995), the consensus on inducing poverty-reducing growth includes "investment in poor people's human capital" (p. 2571) and an acknowledgement that "markets may achieve [poverty-reducing growth] best where states do more—by providing infrastructural, public or merit goods—to enable the poor to be part of [the supply] response [to economic adjustment]"(p. 2570). It may also be that, at higher levels of public investment, the effects of crowding out (in particular, of private investment) would increase. This would have a negative impact on the ability of the poor to exchange their most important asset, labor.

[13] The complex web of associations, that tends to characterize the evolution of socioeconomic processes works in tandem with a general lack of theoretical guidance on model specification to generate econometric results that are often not robust to (minor) changes in specification. For example, countries with more efficient bureaucracies tend to also perform better on dimensions such as the rule of law, corruption, financial development, and economic freedom. In addition, there may be a difference in the time dimension for separate transmission channels. For example, investments in education have stronger effects in the longer term. In addition to generating fragile estimates, this set of conditions implies that the resulting statistical bias, either in terms of magnitude or sign, is impossible to predict.

[14] For a discussion of both sources of bias, see Caselli, Esquivel, and Lefort (1996) and Durlauf, and Quah (1999). For the original presentation of the GMM estimator, see Hansen (1982), and for applications in the context of economic growth, see Tsangarides (2002), Hoeffler (2000), and Bond, Hoeffer, and Temple (1999).

specifications; and (iii) explicitly account for model uncertainty. While preferable, option (iii) presents enormous challenges at the level of both concept and statistical theory. Option (ii), although unsystematic, is preferable over option (i) but poses substantial logistical challenges. In practice, researchers tend to focus on one "channel" and choose option (i), ignoring model uncertainty altogether and risking overconfident inferences.[15] In theory, accounting for model uncertainty requires some version of a "robustness check," essentially an attempt to account for all possible combinations of predictors. This paper employs a Bayesian-type robustness check.

36.   With income distribution data, a third potential econometric problem centers on measurement error, either random or systematic. Similar to DK and Forbes (2000), this paper addresses this issue by employing an improved data set, originally compiled by Deininger and Squire (1998). The next two sections describe, first, the systems GMM panel data estimator, and second, a procedure for assessing the robustness of explanatory variables, the Bayesian averaging of classical estimates (BACE).

A. GMM: A Consistent Panel Data Estimator

37.   GMM estimators hold the potential for both consistency and efficiency gains by exploiting additional moment restrictions. The systems GMM estimator used in this paper involves the estimation of two equations, one in levels and the other in differences. The estimates from the difference equation, constructed by taking first differences of the levels equation, account for country-specific effects by eliminating the country-specific effect, μ_c. For both equations, potentially endogenous explanatory variables are instrumented with their own lagged values. Estimating the equations as a system, the procedure constrains similar coefficients to be constant across equations.

38.   To the extent that the lagged values of the regressors are valid instruments, this GMM estimator addresses consistently and efficiently both sources of bias. In evaluating the issue of weak instruments in panel data models, Blundell and Bond (1998) provide simulation-based evidence that the systems GMM estimator has better finite sample properties than alternative estimators, such as the differenced GMM estimator used by Caselli, Esquivel, and Lefort (1996)—which essentially uses only the estimates from a differences equation. The assumption that the instruments are uncorrelated with the error terms is tested using the Sargan J-test for overidentifying restrictions, as suggested by Newey and West (1987).

B. BACE: A Bayesian Approach to Model Uncertainty

39.   To effectively sort out the underlying empirical model, econometricians employ two types of robustness checks: the Levine and Renelt (1992) version labels any variable that turns insignificant (under any specification) as "fragile," while the Sala-i-Martin (1997) version assigns a "level of confidence" to each variable with the label of "robust" attributed to those that are statistically significant in 95 percent of the alternative set of regressions. To date, these procedures have been applied only in the context of economic growth studies. The first

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[15] See, for example, Leamer (1978) and Raftery (1996).

procedure, an extreme bounds analysis based on Leamer (1983), typically results in few variables being labeled as robust, while the second procedure, a Bayesian approach, suggests that a relatively large number of variables are significant determinants of growth. The Levine and Renelt (1992) version has been criticized for its restrictiveness,[16] while that of Sala-i-Martin (1997) has been criticized for the simplifying assumptions of a fixed model size and the use of a set of "fixed regressors" in each specification.

40.   A conceptually attractive solution to the problem of model uncertainty is provided by Bayesian model averaging (BMA) although difficulties at the implementation stage sometimes render it impractical.[17] In particular, with a large number of regressors, K, the procedure may be infeasible owing to the large number of models to be estimated, 2^K. Additionally, the researcher is required to specify the prior distributions of all relevant parameters. In practice, most applications of BMA utilize an arbitrary set of priors, without examining the impact of this choice.

41.   This paper employs a modified version of BMA, which Doppelhofer, Miller, and Sala–i–Martin (2000) have labeled as the "Bayesian averaging of classical estimates (BACE)," in evaluating the results of a universe of models generated by a set of possible regressors.[18] This approach provides certain advantages over previous studies and even over the fully Bayesian approach of both Brock and Durlauf (2000) and Fernandez, Ley, and Steel (2001). Significantly, BACE does not require the choice of (arbitrary) priors for all the parameters—instead, only one "hyper-parameter" is specified, the expected model size, *kbar*; and the weights assigned to the different models are proportional to the log-likelihood function, an intuitively appealing alternative. Econometrically, the application herein differs from Doppelhofer, Miller, and Sala–i–Martin (2000) in three important ways: (i) the use of an unbalanced panel instead of balanced cross-section data; (ii) the use of the systems GMM estimator instead of ordinary least squares; and (iii) the estimation of the full set of models relying on a random sample of the universe of models.

VI. ECONOMETRIC RESULTS

A. The Impact of Model Uncertainty

42.   Table 1 presents an initial evaluation of the fragility of the determinants of poverty. The second column, labeled as "DK," replicates the DK results, including the marginal significance

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[16] The usual argument is that, given a nonzero probability of a Type I error, it would always be possible to find some specification that renders insignificant any robust determinant.

[17] Madigan and Raftery (1994) show that BMA provides optimal predictive ability. Hoeting and others (1999) summarize recent work using BMA. Brock and Durlauf (2000) provide an accessible explanation of criticisms levied at growth empirics and the contribution of Bayesian analysis in dealing with model uncertainty.

[18] The technical presentation in Appendix I supplements the overview provided in this section.

of lower inflation. The next three columns indicate how drastically the policy conclusions can change with relatively small variations in the set of explanatory variables. For example, a simple test of the importance of private and public investment in explaining poverty might add measures for each of these variables to the DK specification, as in alternative 1. The hypothesis mentioned in an earlier section that public investment might be super pro-poor is in fact corroborated, but now government consumption is also marginally significant, and the set of super-pro poor policies is now at three.

43.   Another hypothesis mentioned earlier is the possibility that growth from different sources (namely, agricultural and nonagricultural) has different impacts on the poor. Alternative 2 tests for such an effect by adding a variable measuring the labor productivity of the agricultural sector (relative to productivity economy-wide). In addition, this specification also controls for a potentially important source of exogenous shocks, changes in the terms of trade. Now, terms of trade emerges as the only variable with a significant direct impact on the income of the poor.

44.   Suppose instead that the researcher, focusing the search on identifying policies and conditions with differing impacts on growth and poverty, decides to include a set of explanatory variables more representative of typical growth equations, as in alternative 3. Suddenly, the relationship between growth and poverty is (statistically) less than one-to-one, in contrast to the DK finding, and the set of super pro-poor policies or conditions is now significantly expanded to include inflation, income inequality, schooling, life expectancy, and financial development.[19] These results not only confirm the tendency for empirical investigations into socioeconomic phenomena to yield fragile econometric estimates but also underscore the importance of a formal robustness check.[20]

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[19] Econometrically, the validity of the instruments used in each of the four formulations is not rejected by the test on overidentification, thereby suggesting that the specifications are acceptable.

[20] Although DK do engage in a "series of robustness checks" (p. 20), these are limited to (i) adding regional dummies, and (ii) dropping a subset of observations for which distribution data may be less reliable. As such, the DK tests do not constitute a comprehensive solution to the problem of model uncertainty.

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Table 1. Determinants of the Income of the Poor (Lowest Quintile)
GMM System Estimation on Levels and Difference Equations 1/ 2/ 3/

Regressors	Specification			
	DK	Alternative 1	Alternative 2	Alternative 3
Constant	-1.76 **	-1.60	-1.28	0.74
Log (average GDP)	1.11 ***	1.10 ***	1.03 ***	0.82 ***
Log (private invest. to GDP)		-0.07	-0.03	
Log (public invest. to GDP)		0.07 *	0.03	
Log (overall invest. to GDP)				0.01
Inequality (Gini) index				-0.04 ***
Log population growth				0.00
Nat. resource exports (to GNP)				0.03
Secondary schooling (years)				0.03
Log of inflation	-0.14 *	-0.20 **	-0.08	-0.05 **
Fiscal balance (to GDP)			-0.55	-0.29
Trade openness ($X + M$ as share of GDP)	0.08	0.05		-0.01
Terms of trade (growth)			1.55 ***	0.23
Primary schooling				-0.04 ***
Life expectancy				0.02 ***
Financial depth (M2 to GDP)			0.12	0.08 *
Ratio of deposit money bank assets	-0.19	-0.16		
Relative agric. labor productivity			0.15	-0.05
Civil war (in last ten years)				-0.02
Democracy index				0.00
Arable land average				0.02
Government consumption (to GDP)	-0.61	-0.87 *	-0.97	-0.32
Rule of law	-0.02	0.07		-0.01
Change in democracy index				0.01
Memorandum items:				
POID 4/	0.40	0.72	0.60	0.60
No. of observations	241	198	169	107
P-value H_0:				
Log (average GDP) = 1	0.27	0.42	0.85	0.01

Sources: See Appendix Tables A1 and A2 for data description; and authors' calculations.

1/ The dependent variables in the system are the level and first difference of log (income of the poor). Unless otherwise indicated, all regressions include regional dummies.
2/ One, two, and three asterisks denote statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.
3/ For the system estimation, only ln (per capita income) is treated as endogenous. For the levels equation, the instrument is growth in mean income over the five years prior to t; for the differences equation, the instruments are the level of mean income at the beginning of the period and the growth of mean income for the five years preceding t-k.
4/ The probability value of overidentifying restrictions (POID) is calculated as the J-statistic multiplied by the number of observations. Under the null hypothesis that the overidentifying restrictions are valid, this statistic is asymptotically distributed Chi-square, with degrees of freedom equal to the number of overidentifying restrictions.

B. Robust Determinants of Poverty

45. Table 2 presents the results of the robust estimation, based on the results of estimating a universe of approximately 2^{18} regressions and with a prior model size (*kbar*) of nine regressors.[21] The Bayesian nature of the procedure implies that it is possible to define different estimates, with the appropriateness of a particular estimate depending on the intended use. The conditional mean and variance, shown in the second and third columns, reflect only the regressions in which the variable actually is used. The interpretation for the conditional mean in the Bayesian framework is that the researcher has a prior of one for the particular variable and priors equal to *kbar* divided by the total number of variables for the remaining variables. The conditional standard deviation does provide one measure of how well a particular variable is estimated, but the ratio of the mean to the standard deviation cannot, strictly speaking, be interpreted as a *t*-statistic, as noted by Doppelhofer, Miller, and Sala-i-Martin (2000, p. 24).

46. The fourth column shows the sign certainty probability, a measure of the significance of each variable, defined as the probability that a coefficient has the same sign as its (posterior) mean. A sign certainty probability equal to one means that the variable has the same sign in every single regression in which it is included, a clear indication of a robust relationship. In earlier investigations, Sala-i-Martin (1997) has attempted to assess robustness by estimating the area under the normal CDF(0), a concept analogous to the sign certainty probability. The shaded area comprises those variables for which the sign certainty probability is at least 90 percent, the equivalent to performing a one-sided test of significance at the 10 percent level in classical statistics.[22] In this case, the choice of cutoff is merely indicative of a set of variables that are relatively well estimated or, to use the common expression, robust.

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[21] The limit of 18 explanatory variables is a result of computational constraints. The choice of *kbar* is essentially ad hoc, but Appendix II provides evidence that the results in Table 2 are not sensitive to this choice.

[22] While the chosen cutoff is not strictly grounded in statistical theory, for each individual regression, the posterior density (from which the sign certainty probability is calculated) is equal to the classical sampling distribution of the coefficient. Overall, however, the posterior density is not a sampling distribution; this is also why the ratio of the conditional mean to the standard deviation cannot be interpreted as a *t*-statistic, as noted previously.

Table 2. Robust Determinants of the Income of the Poor 1/

Regressors	Posterior Mean Conditional on Inclusion	Posterior Variance Conditional on Inclusion	Sign Certainty Probability	Elasticity at Country Group Sample Means 2/	
				Low	Very Low
Log (average GDP) 3/	0.940	0.007	1.00	0.940	0.940
Inequality (Gini) index	-0.037	0.000	1.00	-1.537	-1.755
Log of inflation	-0.029	0.002	0.98	-0.029	-0.029
Secondary schooling (years)	0.029	0.001	0.98	0.027	0.018
Financial depth (M2 to GDP)	0.063	0.004	0.98	2.258	1.783
Gov. consumption (to GDP)	-0.275	0.163	0.96	-0.035	-0.042
Terms of trade (growth)	0.178	0.046	0.93	0.147	0.026
Nat. resource exports (to GDP)	-0.073	0.028	0.90	-0.009	-0.011
Log (overall invest. to GDP)	0.020	0.002	0.85		
Fiscal balance (to GDP)	-0.417	0.120	0.80		
Trade openness ($X + M$ as share of GDP)	-0.054	0.004	0.68		
Primary schooling	-0.020	0.000	0.67		
Arable land average	-0.011	0.000	0.64		
Life expectancy	0.014	0.000	0.63		
Civil war (in last ten years)	0.007	0.001	0.51		
Democracy index	-0.001	0.000	0.50		
Relative agricultural labor productivity	-0.065	0.003	0.47		
Population growth	1.299	3.926	0.27		

Sources: See Appendix Tables A1 and A2 for data description; and authors' calculations.

1/ Bayesian model averaging techniques are applied using a panel data systems GMM estimator;
the dependent variables are the level and the first difference of the logarithm of the income of the lowest quintile.
The prior on mean model size (*kbar*) is 9; qualitative conclusions are robust to a different *kbar* as shown in Appendix II.
2/ Classification based on level of average income of the poor; see data section for details.
3/ Average income is always included in the set of regressors.

47. The results from the robustness test can be summarized as follows:

- The effect of an increase in average income on the income of the poor is positive and significant, confirming the regression results presented in Table 1 and those of previous researchers.[23] Thus, this study provides further empirical evidence that increases in average income as an important avenue for poverty reduction.

- The coefficient on average income is less than one-to-one when the effects of other variables are taken into account, also confirming the regression results in Table 1 but in contrast with the results of DK.[24] While the estimated coefficient on average income is close to one, the hypothesis that it is one is not confirmed by the statistical tests. This result, while not weakening the strong impact of economic growth on

[23] See, for example, the papers by Dollar and Kraay (2001) and Roemer and Gugerty (1997).

[24] See Foster and Szekely (2001) for an exhaustive survey and further evidence on the growth elasticity of the income of the poor.

poverty reduction, implies that, for a given target of poverty reduction over a certain period of time, the economic growth rates required may exceed what can be reasonably expected (than if the coefficient of average income were one or higher).[25]

- An interesting finding of this paper is the identification of four "super pro-poor" conditions—low inflation, a high level of schooling, a high level of financial development, and small government size (captured by government consumption)— that are influenced by policy. These policy variables are super pro-poor in the sense that they raise the income of the poor directly (as well as through the growth channel). In each case, the direct effect, as estimated above, and the indirect effect, as typically estimated in the growth literature, are mutually reinforcing.[26] In other words, there are no identified trade-offs between growth promotion and poverty alleviation.

- The results on the impact of policy-related variables on poverty stand in contrast to previous studies (namely, DK), which find that, once the effect of overall income has been taken into account, there exist no such super pro-poor policies; the results do confirm those of Collier and Dollar (2001), who find that the policy environment has a direct impact on poverty reduction. The result on the impact of inflation confirms that of Easterly and Fischer (2001), who find that direct measures of the well-being of the poor (for example, the change in their share of national income and the real minimum wage) are negatively correlated with inflation.

- In concert with the literature on the joint determination of growth, income and poverty, the high statistical significance of income inequality confirms that it is an important determinant of poverty. Lower levels of inequality are found to have a direct, beneficial impact on poverty reduction.[27]

- The finding on the terms of trade suggests that the poor may be especially vulnerable to adverse movements in the price of tradables. This would be consistent with the usual characterization of the poor as net sellers of tradables.

- The direct negative impact of dependence on natural resource exports is consistent with the nonintegrated nature of these sectors in low-income countries. It is common,

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[25] It bears emphasizing that this implication would also hold for a coefficient of one for average income if the time horizon set for the poverty reduction target is short enough.

[26] For the effects on growth, see Fischer (1993) and Easterly and Fischer (2001) on inflation; Mankiw, Romer, and Weil (1992) on schooling; King and Levine (1993) on financial development; and Fischer (1993) and Easterly and Rebelo (1993) on government consumption.

[27] The estimate of the coefficient of overall income is robust to the inclusion of additional inequality-related terms. This study specifically tested for nonlinear effects in the context of robust estimation and for threshold effects in the context of single regressions.

for example, for oil rents to accrue (almost) entirely to the treasury with very few (backward or forward) linkages from the sector to the rest of the economy. Inefficiencies in government expenditures would then combine with the induced ("Dutch disease") incentives against the production of other tradables to have a negative impact not just on overall growth, as in Leite and Weidmann (1999), but also on poverty, as suggested by the results herein. It would thus appear that, for the poor, natural resource riches are double cursed.

- The results indicate that a number of variables—such as trade openness, the investment rate, budgetary stance, extent of democracy, life expectancy, and extent of civil wars—that have been shown in the empirical literature to have an impact on overall economic growth, do not directly influence the income of the poor (once the level of overall average income has been accounted for). As regards trade openness, the theoretical literature indicates that, over the medium term, it helps poverty alleviation through its effects on the rate and the efficiency of the sectoral pattern of growth. Empirically, the literature on the links between international trade and poverty is in its infancy, and the theoretical literature does recognize that trade reform could have "… redistributive effects on income which can hurt the rich and the poor alike" (Bannister and Thugge, 2000, p. 4).

VII. POLICY IMPLICATIONS AND CONCLUSIONS

48.   The paper investigates the existence of "super pro-poor policies," that is, policies that directly influence the income of the poor after accounting for the effect of growth. The relevance of the findings of this paper is strengthened by the use of three econometric tools: a dynamic panel estimator, which allows the results to be interpreted as measuring how changes in the income of the poor are related to changes in average income, both across countries and within a given country; a formal, Bayesian-type robustness check, which explicitly accounts for model uncertainty; and a wide set of poverty determinants.

49.   The empirical findings indicate that growth is an important vehicle for poverty reduction, thereby confirming the results of previous studies. Nonetheless, the results also indicate that the impact of economic growth is less than one-to-one, which implies, that for a given target of poverty reduction over a certain period of time, the economic growth rates required may exceed what can be reasonably expected (than if economic growth resulted in a one-to-one or higher increase in the income of the poor). This result also implies that there is a role for policies that take into account the distributional impact of economic growth.

50.   This paper identifies a set of super pro-poor policies—that is, those that lower inflation, reduce government size, deepen the financial sector, and raise educational achievement. However, the paper does not investigate the channels through which these policy-related variables directly influence the income of the poor. For such an evaluation, it would be necessary to specify relevant transmission mechanisms and to rigorously test their empirical relevance.

51.   The results in this paper are based on the average experience of a large number of countries and, therefore, should not obscure the importance of dealing effectively with country-specific circumstances. The links between policy and institutional reform, on one hand, and

policy and the income of the poor, on the other, are complex, with many transitions taking place under the surface of a generally favorable impact. Although this paper does reaffirm the primacy of improving average income among the actions that can be taken to generate sustainable poverty alleviation, the methodology herein does not constitute an investigation into how growth and poverty reduction and their underlying determinants are explicitly interconnected.

Table A1. Sample Data: Variable Definitions and Sources

Variable	Source	Definition
Dependent variable		
YP	DK	Logarithm of average income in lowest quintile; constant 1985 US dollars at PPP.
Explanatory variables		
Y	DK	Logarithm of average per capita overall income; 1985 US dollars at PPP.
GINI	DK	GINI coefficient (initial value).
Internal environment / resources		
LPOPGR	WEO	Logarithm of population growth rate, average over specified period.
NATRESAV	Leite & Weidmann	Natural resource exports as share of GNP.
AGRPRODAV	DK	Labor productivity in agriculture relative to economy-wide labor productivity, measured as current-price LCU value added in agriculture/agricultural labor force divided by current price LCU GDP, divided by total labor force average over five years, up to and including indicated year.
LANDAV	DK	Logarithm of arable land per capita, hectares, average over five years, up to and including indicated year.
EHET	Sambanis	Ethnic heterogeneity; sum of racial division, national language division, and religious division (Vanhanen, 1999).
ELFO	Sambanis	Updated index of ethnolinguistics fractionalization.
Institutions / governance		
RULELAW	DK	Rule of law index 1997-98; higher values indicate stronger rule of law; time invariant.
VOICE	DK	Index of formal democratic institutions, greater values indicate more democracy, 1997-98, time invariant.
POLL1	Sambanis	Aggregate index of autocracy and democracy; lagged once (Source: Polity 98).
DEMCHGL	Sambanis	Annual change in the democracy index, lagged once (Source: Polity 98).
FREE	Freedom House	Index of civil liberties.
POLR	Freedom House	Index of political rights.
PW10	Sambanis	Incidence of civil war over the last ten years.
Human capital		
PRIMEDAV	DK	Average stock of years of primary education; average over five years, up to and including indicated year.
SECEDAV	DK	Average stock of years of secondary education; average over five years, up to and including indicated year.
AILITTAV	World Bank	Adult total illiteracy ratio; average over specified period.
LFEEXPTAV	World Bank	Life expectancy at birth (total); average over specified period.
Physical capital		
LNINVPRIINI	WEO	Logarithm of private investment as a share of GDP; constant LCU; initial value of specified period.
LNINVPUBINI	WEO	Logarithm of public investment as a share of GDP; constant LCU; initial value of specified period.
LNIINI	WEO	Logarithm of overall investment as a share of GDP; constant LCU; initial value of specified period.
Macroeconomic stability		
LNINFLAV	DK	Logarithm of 1+inflation rate; average over five years, up to and including indicated year.
BALYAV	WEO	Government balance as share of GDP; current LCU; average over specified period.
GOVAV	DK	Government consumption as share of GDP; current LCU; average over five years, up to and including indicated year.
Trade regime		
IMPTAXAV	DK	Import taxes collected as share of imports; current LCU; average over five years, up to and including indicated year.
OPENAV	DK	Exports plus imports as share of GDP at PPP; average over five years, up to indicated year.
External environment		
TOTGRAV	WEO	Terms of trade (goods and services) growth, average over specified period.
Financial Development		
DMBCBAV	DK	Ratio of assets of deposit money banks to total bank assets; average over five years, up to and indicated year.
BRMYav	WEO	Ratio of broad money to GDP; average over specified period.
Dummy variables		
EAP	DK	East Asia and Pacific regional dummy.
ECA	DK	Europe and Central Asia dummy.
MENA	DK	Middle East and North Africa dummy.
LAC	DK	Latin America and Caribbean dummy.
SA	DK	South Asia dummy.
SSA	DK	Sub-Saharan Africa dummy.

Table A2. Sample Data: Country Group Unweighted Averages

Variable	\Country Group 1/				Overall
	High	Medium	Low	Very low	
Log (income of poor)	8.33	7.41	6.50	5.34	6.89
Log (average GDP)	9.30	8.53	7.75	6.84	8.10
GINI (inequality index)	31	35	42	47	39
Internal environment / resources					
POPGR (in percent)	0.7	1.3	2.1	2.8	1.8
NATRESAV (in percent)	9.5	14.4	12.9	15.3	10.1
AGRPRODAV (ratio; in percent)	86.1	74.2	68.7	77.8	73.1
LANDAV (in logs)	-1.35	-1.27	-1.04	-0.90	-1.09
EHET (index: 0-100)	22	31	40	71	38
ELFO (index: 0-100)	24	21	38	60	33
Institutions / governance					
RULELAW	1.43	0.51	-0.27	-0.42	0.27
VOICE	1.30	0.73	-0.12	-0.22	0.37
POLL1	8.33	3.20	1.38	0.77	2.95
DEMCHGL	0.01	0.12	0.11	0.40	0.12
POLR	1.63	3.55	4.07	4.73	3.09
FREE	1.70	3.69	4.10	4.81	3.15
PW10	0.04	0.00	0.37	0.32	0.21
Human capital					
PRIMEDAV (years)	5.25	4.13	2.74	2.56	2.78
SECEDAV (years)	2.45	1.55	0.94	0.62	1.07
AILITTAV (illiteracy ratio)	7.96	13.64	30.64	43.86	21.59
LFEXPTAV (years)	73.85	68.73	62.99	54.27	63.57
Physical capital					
LNIPRIINI (log of share of GDP)	2.89	2.89	2.55	2.42	2.31
LNIPUBINI (log of share of GDP)	1.38	1.69	1.82	1.79	1.42
LNINI (log of share of GDP)	3.18	3.22	3.14	2.97	2.69
Macroeconomic stability					
LNINFLAV (log)	0.07	0.26	0.31	0.21	0.22
BALYAV (in percent)	-2.4	-3.6	-4.7	-5.6	-3.9
GOVAV (in percent)	16.4	16.0	13.3	12.7	14.5
Trade regime					
IMPTAXAV (in percent of imports)	2.6	7.8	12.5	19.4	8.3
OPENAV (in percent)	71.5	45.4	20.9	24.6	36.6
External environment					
TOTGRAV (in percent)	-0.3	1.2	0.8	0.1	0.5
Financial development					
DMBCBAV (share of GDP)	88.5	88.4	70.6	55.5	72.4
BRMYAV (share of GDP)	64.6	52.8	35.8	28.3	44.1
Memorandum items:					
Average number of periods	5	3	3	2	3
Number of countries	20	18	30	17	85

1/ Classification based on the number of standard deviations from the sample mean for the income of the lowest quintile in each country; high (greater than 0.80 deviations), medium (between 0.79 and 0 deviations), low (between -0.01 and -0.75 deviations), and very low (less than -0.76 deviations).

Table A3. Country Group Membership 1/

High	Periods 2/	Medium	Periods
Hungary	5	Slovak Republic	1
France	5	Bahamas, The	3
Singapore	4	Portugal	3
Hong Kong SAR	4	Poland	4
Spain	5	Venezuela, RB	5
Norway	6	Taiwan Province of China	6
Japan	6	Greece	3
New Zealand	3	Bulgaria	1
Italy	3	Trinidad and Tobago	4
Finland	5	Ireland	2
Denmark	4	Belarus	1
Australia	4	Mauritius	2
United Kingdom	6	Estonia	2
Netherlands	4	Puerto Rico	3
United States	7	Latvia	2
Germany	5	Korea, Rep. of	6
Sweden	5	Malaysia	4
Canada	6	Jordan	3
Belgium	2		
Luxembourg	1		

Low	Periods	Very Low	Periods
Nepal	2	Sierra Leone	1
Egypt	3	Tanzania	2
Bolivia	1	Mali	1
Panama	3	Ethiopia	1
Pakistan	5	Lesotho	1
Bangladesh	4	Zambia	2
Seychelles	1	Madagascar	1
China	3	Mauritania	1
Dominican Republic	3	Nigeria	3
Moldova	1	Honduras	3
Tunisia	4	Côte d'Ivoire	1
Brazil	5	El Salvador	3
Indonesia	5	Ghana	2
Ecuador	2	Guyana	1
Russian Federation	2	Guatemala	1
Morocco	1	Philippines	5
Thailand	6	India	6
Colombia	4		
Jamaica	3		
Peru	4		
Sri Lanka	5		
Yemen, Rep. of	1		
Romania	1		
Costa Rica	5		
Turkey	3		
Algeria	1		
Chile	3		
Fiji	1		
Iran, Islamic Rep. of	1		
Mexico	6		

1/ Country groups defined on the basis of income of the poor; see Table A2 for definitions.
2/ Number of periods each country contributes to the data set. A period consists of two observations that are, at a minimum, five years apart.

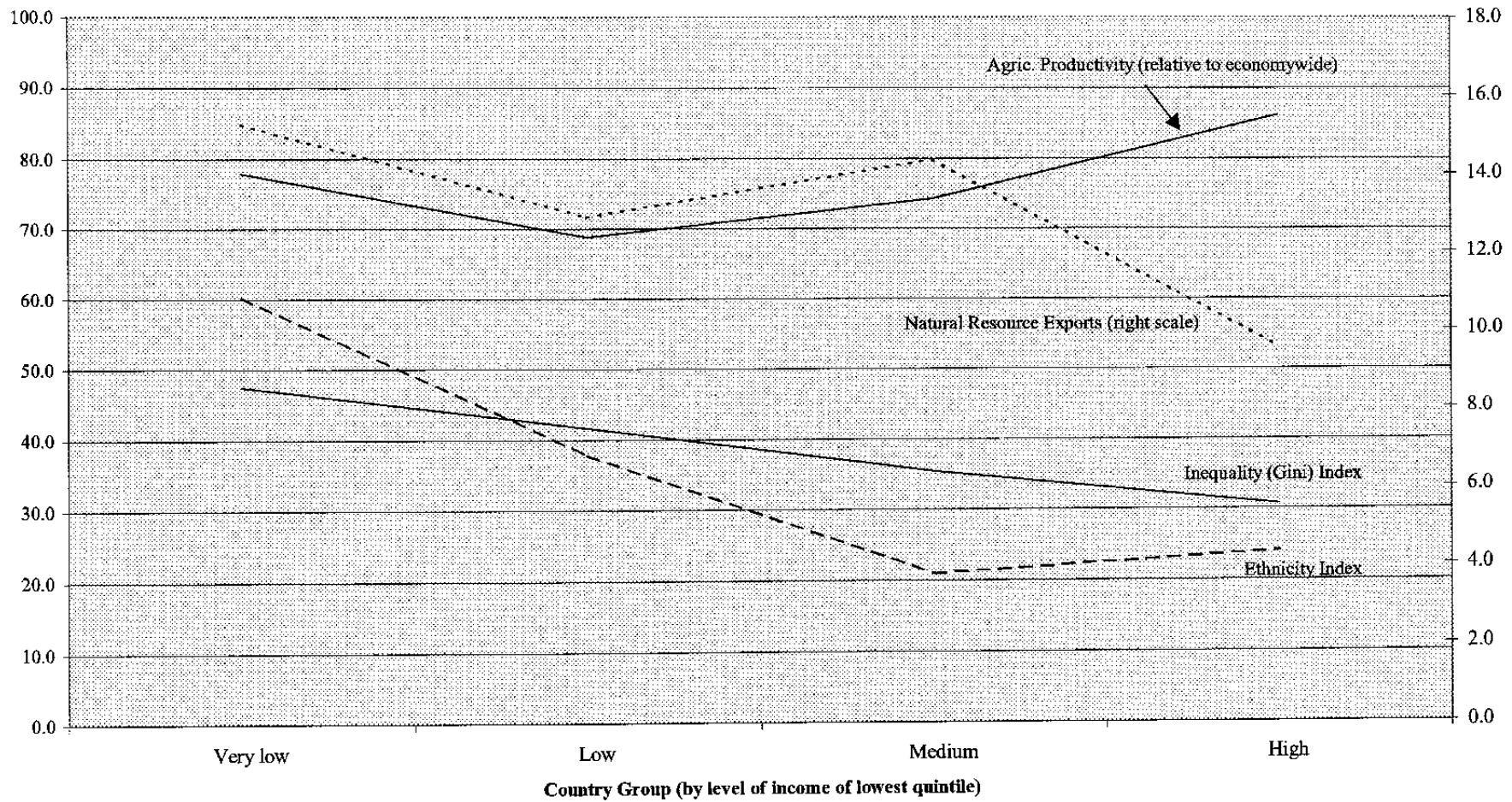Figure A1. Determinants of Poverty: Inequality and Internal Environment

Figure A2. Determinants of Poverty: Institutions / Governance

Index of Autocracy and Democracy (POLL1; higher value = more democracy; left scale)

Civil War (PW10; higher value = higher incidence; right scale)

Rule of Law (higher values = stronger rule of law; right scale)

Index of Civil Liberties (FREE; higher value = fewer liberties; left scale)

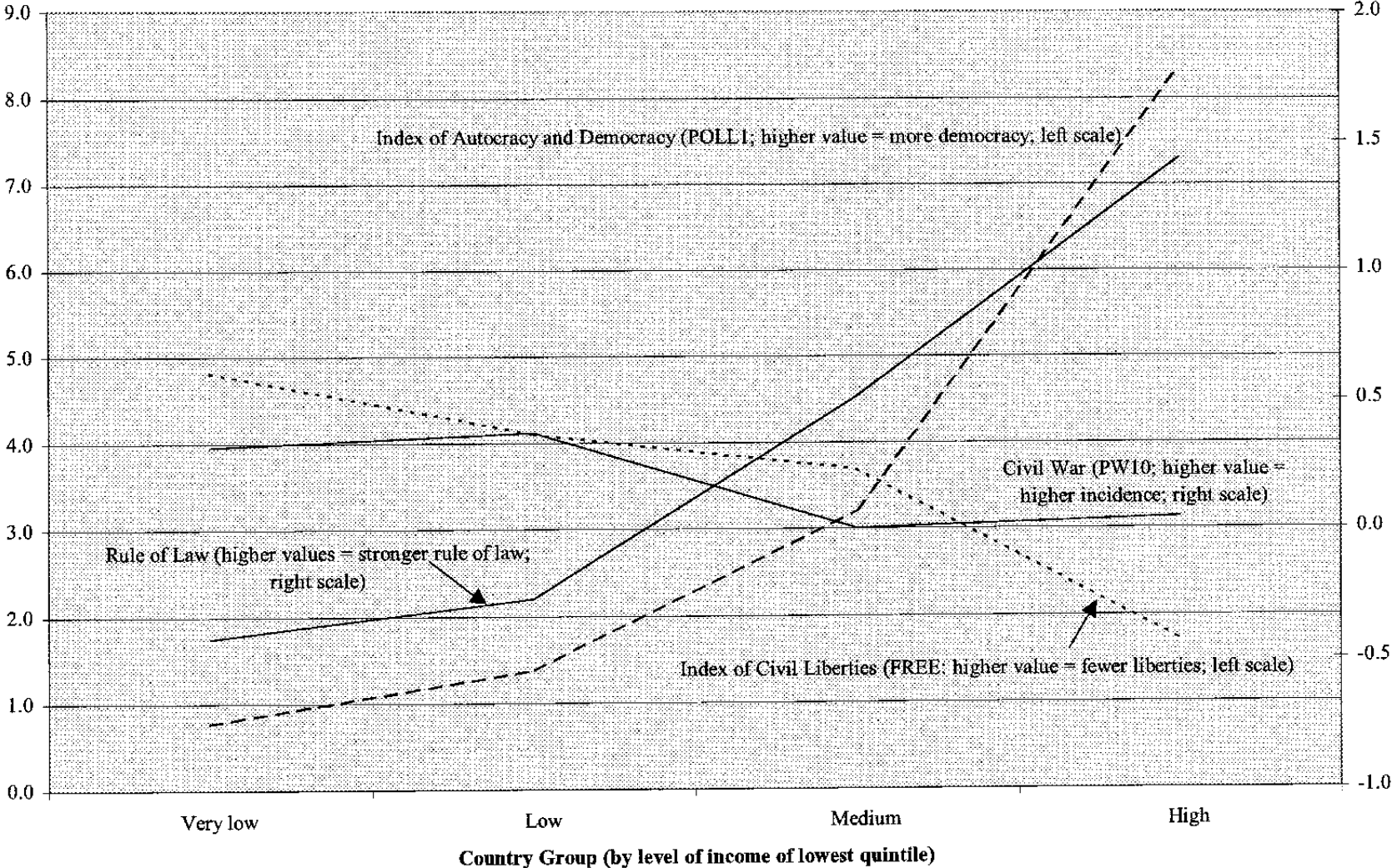Country Group (by level of income of lowest quintile)
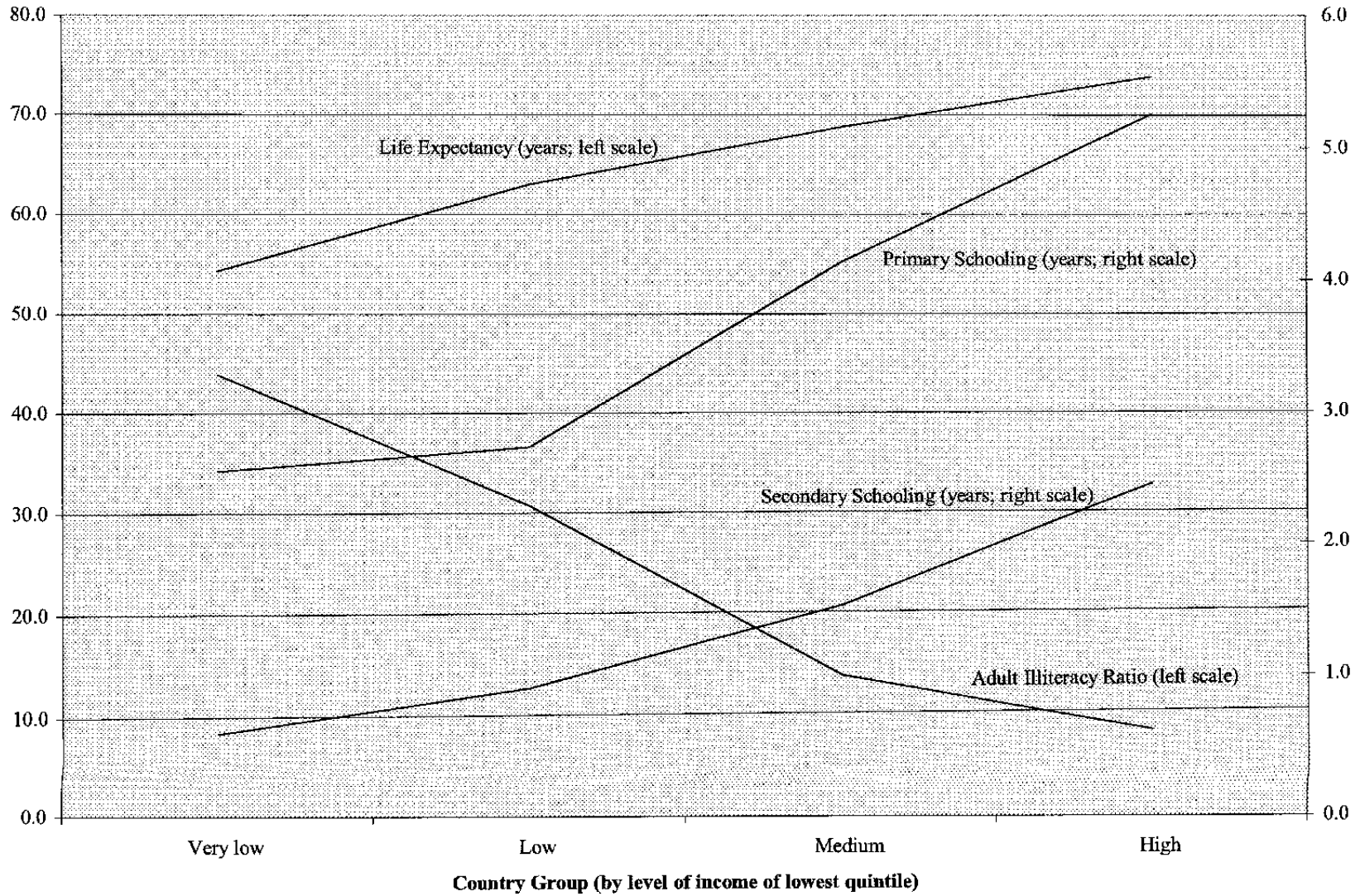
Figure A3. Determinants of Poverty: Human Capital

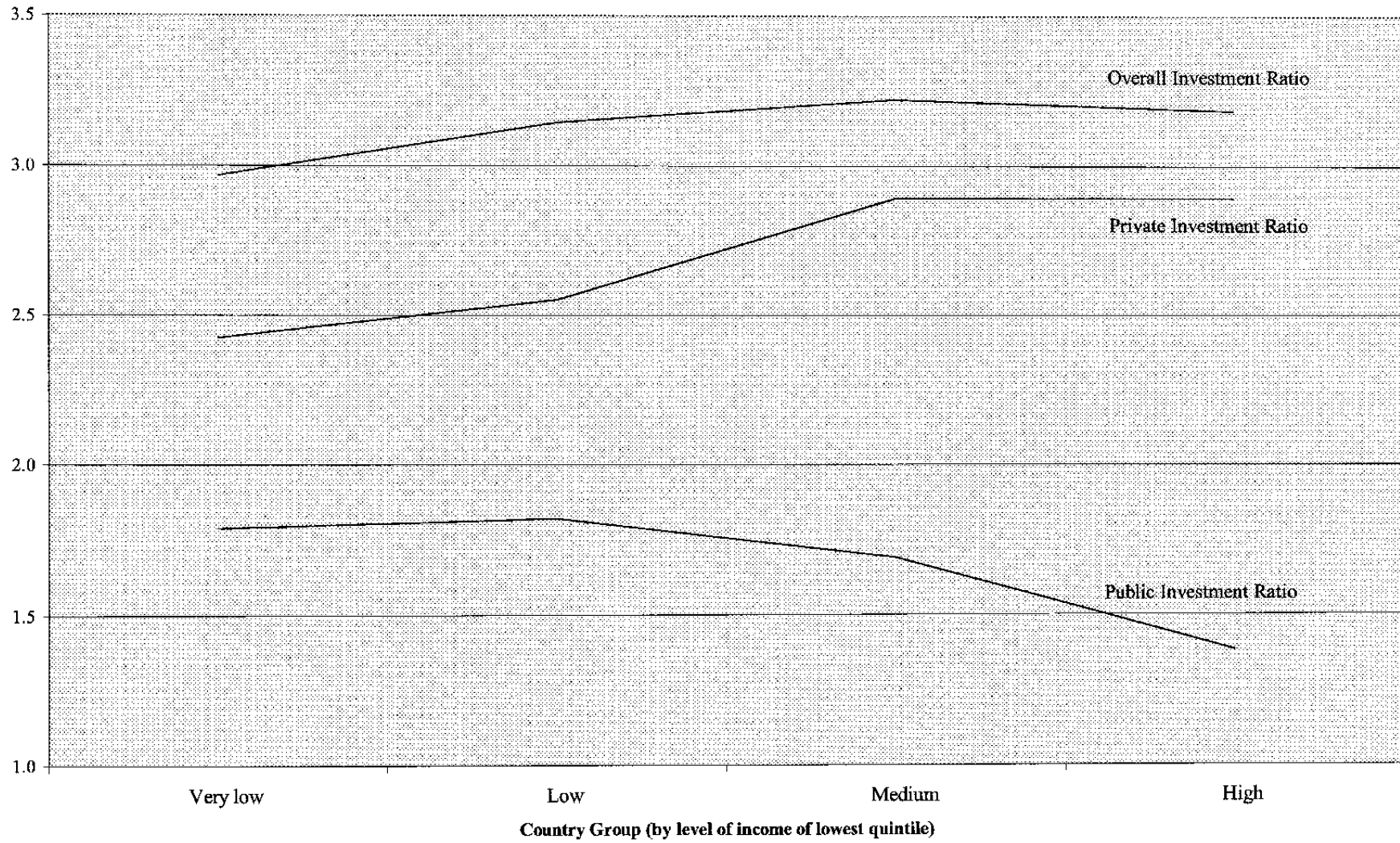Figure A4. Determinants of Poverty: Physical Capital (log of ratio to GDP)

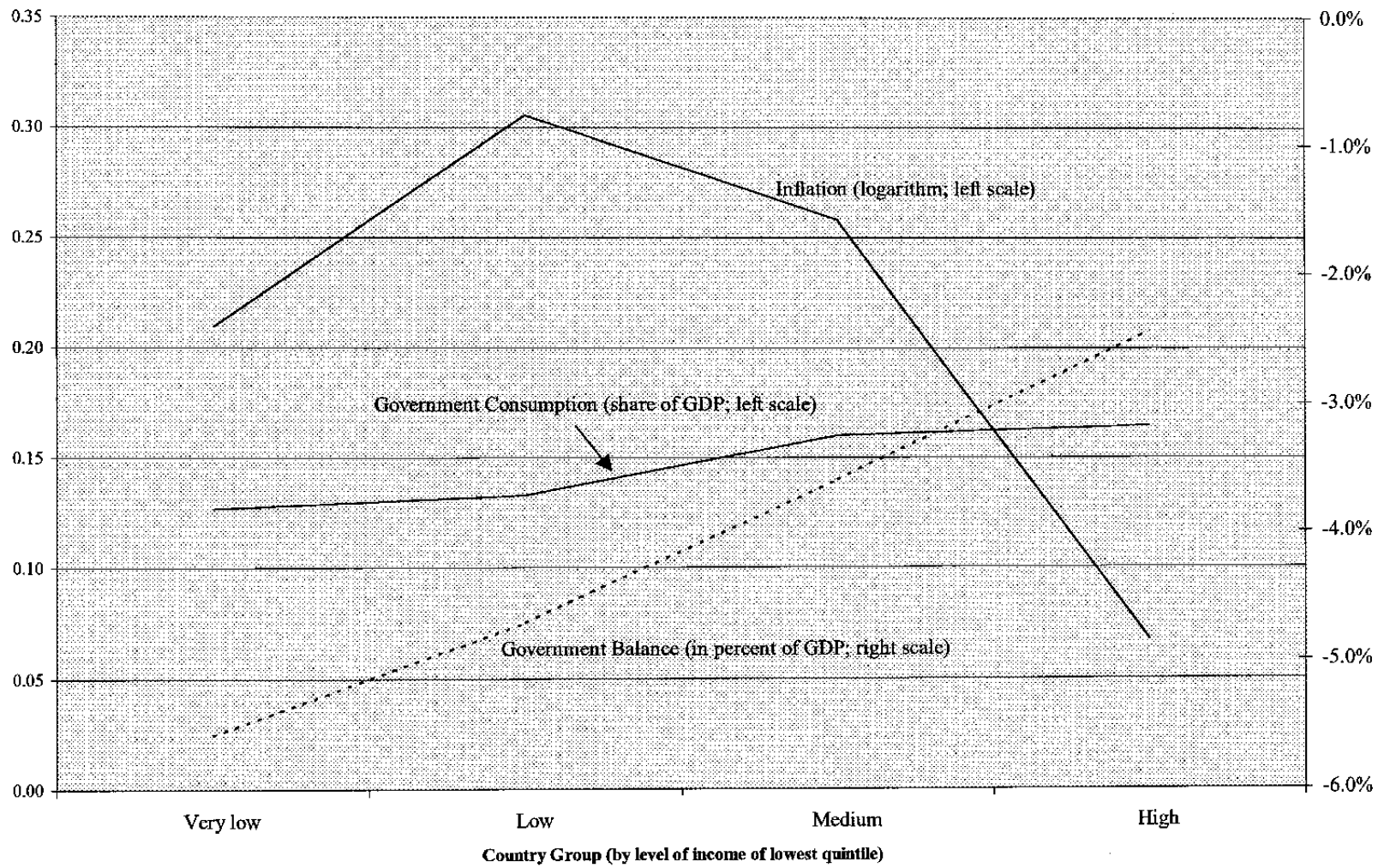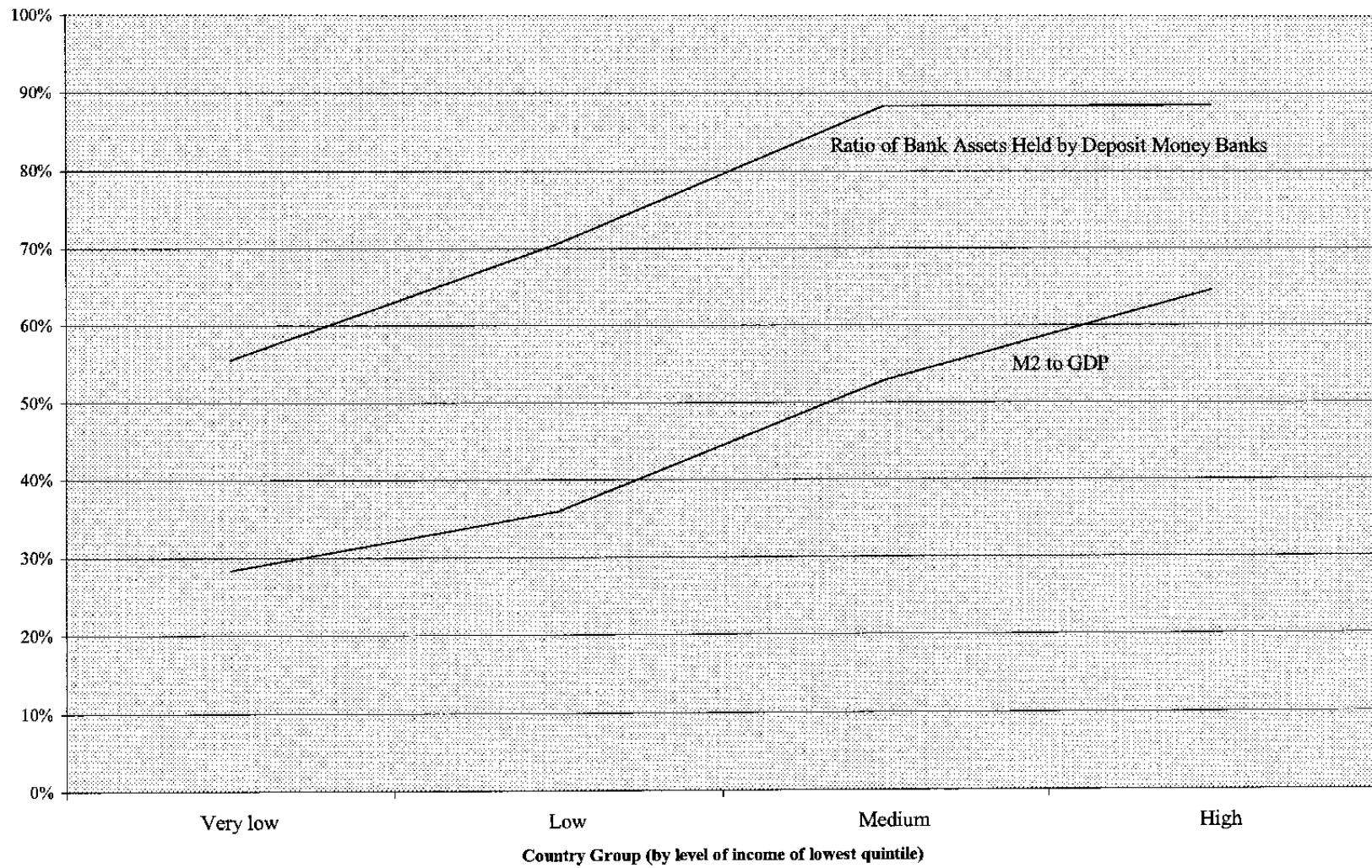Figure A5. Determinants of Poverty: Macroeconomic Stability

Figure A6. Determinants of Poverty: Financial Development

Computational Aspects of Robustness Check

Bayesian estimation expresses all uncertainty in terms of probability, and it views unknown parameters as random variables. To begin, consider that a probability model for data D is specified by a vector of k unknown parameters, θ. Before observing the data, beliefs about θ are represented by a prior probability density, $p(\theta)$. The probability model is specified by the likelihood $p(D|\theta)$, the probability of observing the data D given that θ is the true parameter. After observing the data, beliefs about θ are updated using Bayes' theorem to obtain the posterior distribution of θ:

$$p(\theta \mid D) = \frac{p(D \mid \theta)p(\theta)}{p(D)}, \text{ where } p(D) = \int p(D \mid \theta)p(\theta)d\theta. \tag{A1}$$

Bayesian model averaging is a special case of Bayes' rule. Suppose that is possible to divide the parameter space into regions (models). The posterior distribution of the parameter, given the data is an average of the posterior distribution under each of the models considered, $(M_1, M_2, ...M_k)$, weighted by their posterior model probability:

$$p(\theta \mid D) = \sum_{k=1}^{K} p(\theta \mid M_k, D)p(M_k \mid \theta). \tag{A2}$$

The posterior probability for model M_k is given by the following:

$$p(M_k \mid D) = \frac{p(D \mid M_k)p(M_k)}{\sum_{l}^{K} p(D \mid M_l)p(M_l)}, \tag{A3}$$

where $p(D \mid M_k) = \int p(D \mid \theta, M_k)p(\theta_k \mid M_k)d\theta_k$. \tag{A4}

In practice, specifying priors for a large set of regressors is not feasible.[28] Following Doppelhofer, Miller, and Sala-í-Martin (2000), define the ratio of the posterior probabilities given by the odd prior ratio times the likelihood ratio as

$$\frac{p(M_j \mid y)}{p(M_l \mid y)} = \left[\frac{p(M_j)}{p(M_l)} \right] \times \left[\frac{p(D \mid M_j)}{p(D \mid M_l)} \right] = \left[\left(\frac{\bar{k}}{K} \right)^{k_j - k_l} \left(1 - \frac{\bar{k}}{K} \right)^{k_l - k_j} \right] \times \left[T^{-(k_j - k_l)/2} \left(\frac{\hat{\sigma}_j^2}{\hat{\sigma}_l^2} \right)^{-T/2} \right], \tag{A5}$$

where *kbar* is the researcher's prior about the number of regressors with nonzero coefficients, k_j is the number of included variables in model j, K is the total number of regressors (20 in our case), and *kbar/K* is the prior inclusion probability for each variable.

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[28] A common solution to this problem is to resort to "diffuse prior" specification. This paper does not follow this approach because of difficulties in calculating the posterior odds ratio when the set of regressors differs across models.

Since *kbar* is the only prior "arbitrarily" specified in our simulations, robustness checks on the obtained results were run by changing the value of this parameter. Overall, the stated conclusions were not found to be sensitive to the choice of *kbar*.

Following Doppelhofer, Miller, and Sala-í-Martin (2000), weights are assigned to different models based on the posterior probabilities of each model, essentially by normalizing the weight of any model by the sum of the weights of all possible 2^K models:

$$p(M_j \mid D) = \frac{p(M_j)^{-k_j/2} SSE_j^{-T/2}}{\sum_{l=1}^{2^K} p(M_l) T^{-k_l/2} SSE_l^{-T/2}}. \tag{A6}$$

The following statistics are reported:

- Posterior mean, defined as

$$E(\theta_k \mid D) = \sum_{j=1}^{2^K} p(M_j \mid D) E(\theta_k \mid D, M_j). \tag{A7}$$

- Posterior variance, defined as
$$Var(\theta_k \mid D) = E\big[Var(\theta_k \mid D, M_j) \mid D\big] + Var\big[E(\theta_k \mid D, M_j) \mid D\big]. \tag{A8}$$

- Posterior inclusion probability,
$$p(\theta_k \neq 0 \mid D) = \sum_{\theta_k \neq 0} p(M_j \mid D). \tag{A9}$$

This ranking measure indicates the extent to which the data favor the inclusion of a particular variable in the regression. Specifically, if $p(\theta_k \neq 0 \mid D) > p(\theta_k \neq 0) = \dfrac{\bar{k}}{K}$, the conclusion would be that the variable has a high marginal contribution to the model's goodness of fit.

- Sign certainty probability, defined as
$$p\big[\mathrm{sgn}(\theta_k) = \mathrm{sgn}\, E(\theta_k \mid D) \mid D, \theta_k \neq 0\big]. \tag{A10}$$

This measure conveys the probability that, conditional on inclusion, the estimate coefficient is on the same side of zero as its mean.

- Posterior means and variances conditional on inclusion. These are the ratios of the posterior means and variances, divided by the posterior inclusion probability.

A variable is labeled as "robust" if it has both a small posterior variance conditional on inclusion and a high sign certainty probability.

Sensitivity Analysis on Prior (Model Size)

Posterior Conditional Means and Variances With Different Prior on Model Size (*kbar*)

Regressors	Sign Certainty	kbar = 6 Mean	kbar = 6 Variance	kbar = 8 Mean	kbar = 8 Variance	kbar = 10 Mean	kbar = 10 Variance	kbar = 12 Mean	kbar = 12 Variance
Log (average GDP) 2/	1.00	0.944	0.006	0.942	0.006	0.938	0.007	0.933	0.007
Inequality (Gini) index	1.00	-0.037	0.000	-0.037	0.000	-0.037	0.000	-0.037	0.000
Log of inflation	0.98	-0.028	0.002	-0.029	0.002	-0.029	0.002	-0.029	0.002
Secondary schooling (Years)	0.98	0.028	0.001	0.029	0.001	0.030	0.001	0.031	0.001
Financial depth (M2 to GDP)	0.98	0.067	0.004	0.064	0.004	0.062	0.004	0.060	0.004
Gov. consumption (to GDP)	0.96	-0.280	0.184	-0.274	0.169	-0.278	0.158	-0.292	0.149
Terms of trade (Growth)	0.93	0.166	0.049	0.174	0.047	0.182	0.045	0.193	0.043
Nat. resource exports (to GDP)	0.90	-0.078	0.028	-0.075	0.028	-0.071	0.029	-0.064	0.029
Log (overall invest. to GDP), initial	0.85	0.022	0.002	0.020	0.002	0.019	0.002	0.018	0.002
Fiscal balance (to GDP)	0.80	-0.400	0.119	-0.413	0.121	-0.420	0.118	-0.419	0.113
Trade openness ($X + M$ as share of GDP)	0.68	-0.050	0.004	-0.053	0.004	-0.054	0.004	-0.055	0.004
Primary schooling	0.67	-0.021	0.000	-0.020	0.000	-0.020	0.000	-0.020	0.000
Arable land average	0.64	-0.012	0.000	-0.011	0.000	-0.011	0.000	-0.011	0.000
Life expectancy	0.63	0.014	0.000	0.014	0.000	0.015	0.000	0.015	0.000
Civil war (in last ten years)	0.51	0.009	0.001	0.008	0.001	0.007	0.001	0.005	0.001
Democracy index	0.50	-0.001	0.000	-0.001	0.000	-0.001	0.000	-0.001	0.000
Relative agricultural labor productivity	0.47	-0.064	0.003	-0.065	0.003	-0.066	0.003	-0.068	0.003
Population growth	0.27	1.171	3.736	1.259	3.881	1.336	3.945	1.400	3.874

Sources: See Appendix A for data description; and authors' calculations.

1/ Bayesian model averaging techniques are applied using a panel data systems GMM estimator;
the dependent variables are the level and the first difference of the logarithm of the income of the lowest quintile.
2/ Average income is always included in the set of regressors.

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