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Human capital and growth in cross-country regressions

Robert J. Barro*

Summary

■ The determinants of economic growth and investment are analysed in a panel of about 100 countries observed from 1960 to 1995. The data reveal a pattern of conditional convergence in the sense that the growth rate of per capita GDP is inversely related to the starting level of per capita GDP, holding fixed measures of government policies and institutions and the character of the national population.

For given values of these variables, growth is positively related to the starting level of average years of adult-male school attainment at secondary and higher levels. Growth is insignificantly related to years of female school attainment at these levels or to years of primary attainment by either sex. The strong secondary and higher-schooling effect suggests a paramount role for the diffusion of technology. The weak female-schooling effect suggests that women's human capital is not well exploited in the labour markets of many countries.

Data on students' scores on internationally comparable examinations are used to measure schooling quality. Scores on science tests have a particularly strong positive relation with economic growth. If science scores are held fixed, then results on reading examinations are insignificantly related to growth. (The results on mathematics scores could not be reliably disentangled from those of science scores.) Given education quality, as represented by the test scores, schooling quantity—measured by average years of attainment of adult males at the secondary and higher levels—is still positively and significantly related to subsequent growth. Results on test scores also hold if the estimation is by instrumental variables, where the instrument list includes variables that have significant explanatory power for test scores—prior values of total years of schooling in the adult population (a proxy for parents' education), pupil-teacher ratios, and school dropout rates. ■

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When economists talked in the 1960s and 1970s about the government's macroeconomic policies, they mostly had in mind fiscal and monetary policies. These interventions figured prominently in short-term business fluctuations, the topic that occupied most of the attention of macroeconomists at the time. This emphasis reflected partly the primacy of Keynesian economics, which was born during the Great Depression and, therefore, naturally focused on aggregate-demand management in a short-term context. But even non-Keynesian monetarists were absorbed through the 1970s by questions about how to smooth out the business cycle. To the extent that there was a longer-term focus to macroeconomic policy, it revolved around the saving rate and on how fiscal policy and other factors influenced this rate.

Since the late 1980s, much of the attention of macroeconomists has shifted to longer-term issues, specifically to the effects of government policies on the long-term economic growth rate. This shift reflects partly the recognition that the difference between prosperity and poverty for a country depends on how fast it grows over the long term. Although fiscal and monetary policies matter in this context, other aspects of policy—broadly interpreted to encompass all aspects of government activity that matter for economic performance—are even more important. One of these aspects concerns the character of a nation's basic political, legal, and economic institutions. These institutions typically remain stable from year to year and thus have little to do with the latest recession or boom. But the long-lasting differences in these institutions across countries have proven empirically to be among the most important determinants of differences in economic growth rates and investment.

Human-capital accumulation is an important part of the development process, and this accumulation is influenced in major ways by public programs for schooling and health. Also important are government policies that promote or discourage free markets, including

regulations of labour and capital markets and interventions that affect the degree of international openness. Finally, government policy includes the amount and nature of public investment, especially in areas related to transportation and communication.

The recognition that the determinants of long-term economic growth is the central macroeconomic problem was fortunately accompanied in the late 1980s by important advances in economic-growth theory. This period featured the development of endogenous-growth models, in which the long-term growth rate was determined within the model. A key feature of these models is a theory of technological progress, viewed as a process whereby purposeful research and application leads over time to new and better products and methods of production and to the adoption of superior technologies that were developed in other countries or sectors. One of the major contributions in this area is Romer (1990).

Shortly thereafter, in the early 1990s, there was a good deal of empirical estimation of growth models using cross-country and cross-regional data. This empirical work was, in some sense, inspired by the excitement of the endogenous-growth theories. But the framework for the applied work owed more to the older, neo-classical model, which was developed in the 1950s and 1960s.[1] The framework used in recent empirical studies combines basic features of the neo-classical model—especially the convergence force whereby poor economies tend to catch up to rich ones—with extensions that emphasise the role of government policies and institutions. For an overview of this framework and the recent empirical work on growth, see Barro (1997).

The recent endogenous-growth models are useful for understanding why advanced economies—and the world as a whole—can continue to grow in the long run despite the workings of diminishing returns in the accumulation of physical and human capital. In contrast, the extended neo-classical framework does well as a vehicle for understanding relative growth rates across countries, for example, for assessing why South Korea grew much faster than the US or Zaire during the last 30 years. So overall, the new and old theories are more complementary than they are competing.

[1] See Solow, 1956; Cass, 1965; Koopmans, 1965; the earlier model of Ramsey, 1928; and the exposition in Barro and Sala-i-Martin, 1995.

1. Framework for the empirical analysis of growth

The empirical framework derived from the extended neo-classical growth model can be summarised by a simple equation:

$$Dy = F(y, y^*) \quad (1)$$

where Dy is the growth rate of per capita output, y is the current per capita output level, and y^* is the long-run or target per capita output level. In the neo-classical model, the diminishing returns to the accumulation of capital imply that an economy's growth rate, Dy, is inversely related to its development level, as represented by y.[2] In the present framework, this property applies in a conditional sense, for a given value of y^*.

For a given value of y, the growth rate, Dy, rises with y^*. The value y^* depends, in turn, on government policies and institutions and on the character of the national population. For example, better enforcement of property rights and fewer market distortions tend to raise y^* and, hence, increase Dy for given y. Similarly, if people are willing to work and save more and have fewer children, then y^* increases, and Dy rises accordingly for given y.

In this model, a permanent improvement in some government policy initially raises the growth rate, Dy, and then raises the per capita output level, y, gradually over time. As output rises, the workings of diminishing returns eventually restore the growth rate, Dy, to a value consistent with the long-run rate of technological progress (which is determined outside of the model in the standard neo-classical framework). Hence, in the very long run, the impact of improved policy is on the per capita output level, not its growth rate. But because the transitions to the long run tend empirically to be lengthy, the growth effects from shifts in government policies persist for a long time.

[2] The starting level of per capita output, y, can be viewed more generally as referring to the starting levels of physical and human capital and other durable inputs to the production process. In some theories, the growth rate, Dy, falls with a higher starting level of overall capital per person but rises with the initial ratio of human to physical capital.

2. Empirical findings on growth and investment across countries

2.1. Empirical framework

The findings on economic growth surveyed in Barro (1997) provide estimates for the effects of several government policies. That study applied to roughly 100 countries observed from 1960 to 1990. This sample has now been updated to 1995 and has been modified in other respects, as detailed in the following paragraphs.

This framework includes countries at vastly different economic-development levels, and places are excluded only because of missing data. The attractive feature of this broad sample is that it encompasses great variation in the government policies that are to be evaluated. In fact, my view is that it is impossible to use the experience of one or a few countries to get an accurate empirical assessment of the long-term growth implications from policies, such as legal institutions, size of government, monetary and fiscal policies, and so on.

One drawback of this kind of diverse sample is that it creates difficulties in measuring variables in a consistent and accurate way across countries and over time. In particular, less developed countries tend to have a lot of measurement error in national-accounts and other data. The hope, of course, is that the strong signal from the diversity of the experience dominates the noise.

The other empirical issue, which is probably more important than measurement error, is the sorting out of directions of causation. The objective is to isolate the effects of alternative government policies on long-term growth. But, in practice, much of the government's behaviour—including its monetary and fiscal policies and its political stability—is a reaction to economic events. In most cases discussed in the following, the labelling of directions of causation depends on timing evidence, whereby earlier values of government policies are thought to influence subsequent economic performance. But this approach to determining causation is not always valid.

The empirical work considers average growth rates and average ratios of investment to GDP over three decades, 1965-75, 1975-85, and 1985-95. In one respect, this long-term context is forced by the data, because many of the determining variables considered, such as school attainment and fertility, are measured at best over five-year intervals. Data on internationally comparable test scores are available

even for fewer years. The low-frequency context accords, in any event, with the underlying growth theories, which do not attempt to explain short-run business fluctuations. In these theories, the exact timing of response—for example, of the rate of economic growth to a change in a public institution—is not as clearly specified as the long-run response. So the application of the theories to annual or other high-frequency observations would compound the measurement error in the data by emphasising errors related to the timing of relationships.

2.2. Empirical findings

Table 1 shows panel regression estimates for the determination of the growth rate of real per capita GDP and the ratio of real investment to real GDP.[3] The effects of the starting level of real per capita GDP show up in the estimated coefficients on the level and square of log(GDP). The other regressors include an array of policy variables—the ratio of government consumption to GDP, a subjective index of the maintenance of the rule of law, a subjective index for democracy (electoral rights), and the inflation rate. Also included is a measure of school attainment at the start of each period, the total fertility rate, the ratio of investment to GDP, and the growth rate of the terms of trade (export prices relative to import prices).

1. The per capita GDP level. As is now well known, the simple relation between growth rates and initial per capita GDP levels is virtually nil, as shown in Figure 1. But when the policy and other independent variables shown in Table 1 are held constant, a strong relation exists between growth rate and level. The estimated coefficient is significantly positive for log(GDP) and significantly negative for the square of log(GDP).

[3] The GDP figures in 1985 prices are the purchasing-power-parity adjusted chain-weighted values from Summers and Heston, version 5.6. These data are available on the Internet from the National Bureau of Economic Research. See Summers and Heston (1991) for a general description of their data. Real investment (private plus public) is from the same source.

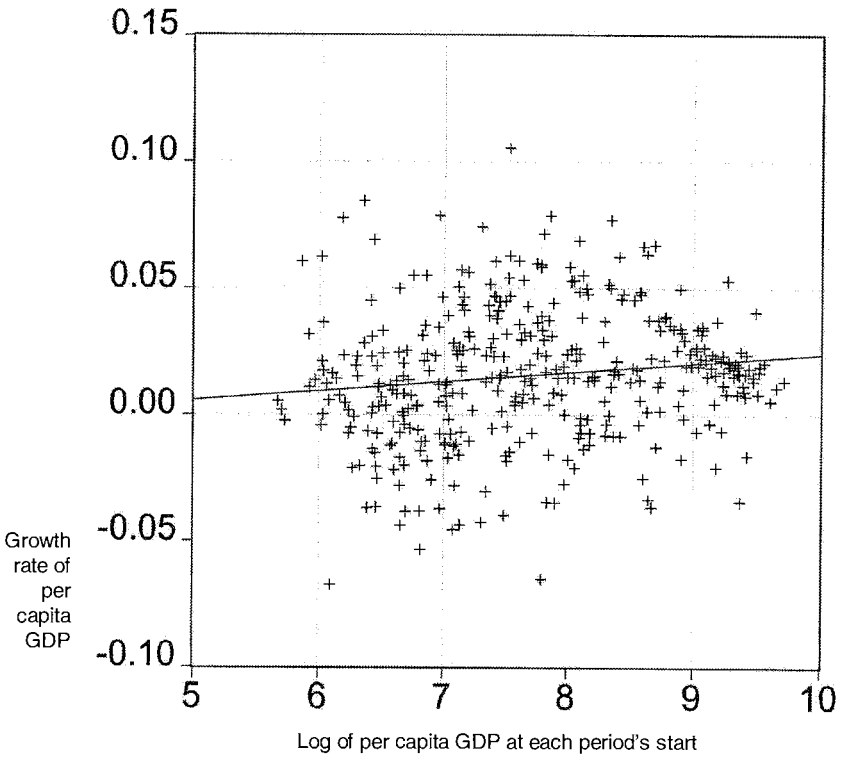
Table 1. Panel regressions for growth rate and investment ratio.

Independent variable	Estimated coefficient for growth rate	Estimated coefficient for investment ratio
Log(per capita GDP)	0.124 (0.027)	0.188 (0.083)
Log(per capita GDP) squared	-0.0095 (0.0018)	-0.0110 (0.0053)
Govt. consumption/GDP	-0.149 (0.023)	-0.271 (0.072)
Rule-of-law index	0.0172 (0.0053)	0.064 (0.020)
Democracy index	0.054 (0.029)	0.072 (0.078)
Democracy index squared	-0.048 (0.026)	-0.086 (0.068)
Inflation rate	-0.037 (0.010)	-0.058 (0.027)
Years of schooling	0.0072 (0.0017)	-0.0013 (0.0058)
Log(total fertility rate)	-0.0251 (0.0047)	-0.0531 (0.0140)
Investment/GDP	0.059 (0.022)	–
Growth rate of terms of trade	0.165 (0.028)	0.052 (0.067)
Numbers of observations	79, 87, 84	79, 87, 85
R^2	0.67, 0.48, 0.42	0.52, 0.60, 0.65

Notes: Dependent variables: The dependent variable in the first panel is the growth rate of real per capita GDP. The growth rate is the average for each of the three periods 1965-75, 1975-85, and 1985-95. The dependent variable in the second panel is the ratio of real investment (private plus public) to real GDP. The measure is the average of the annual observations on the ratio for the periods 1965-74, 1975-84, and 1985-89. Independent variables: Individual constants (not shown) are included in each panel for each period. The log of real per capita GDP and the average years of male secondary and higher schooling are measured at the start of each period. The government consumption ratios (exclusive of spending on education and defence) and investment (private plus public) to GDP, the democracy index, the inflation rate, the total fertility rate, and the growth rate of the terms of trade (export over import prices) are period averages. The rule-of-law index is the earliest value available (for 1982 or 1985) in the first two equations and the period average for the third equation.

Estimation is by three-stage least squares. Instruments are the actual values of the schooling and terms-of-trade variables, lagged values of the other variables aside from inflation, and dummy variables for prior colonial status (which have substantial explanatory power for inflation). The earliest value available for the rule-of-law index (for 1982 or 1985) is included as an instrument for the first two equations, and the 1985 value is included for the third equation. Standard errors are shown in parentheses. The R^2 values apply to each period separately.

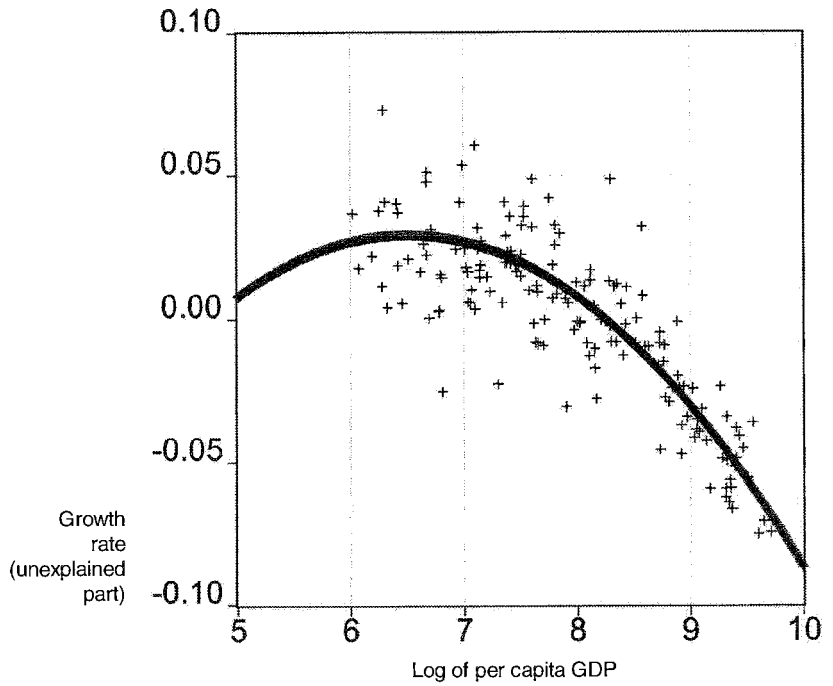
Figure 1. Scatter of growth rate against GDP level.



These coefficients imply the partial relation between the growth rate and log(GDP) as shown in Figure 2.[4] This relation is negative overall but is not linear. For the poorest countries in the sample, the marginal effect of log(GDP) on the growth rate is small and may even be positive. The estimated regression coefficients for log(GDP) and its square imply a positive marginal effect for a per capita GDP level below USD 670 (in 1985 prices). This situation applies mainly to some countries in sub-Saharan Africa—the largest implied positive effect of log(GDP) is 0.016 for Ethiopia in the 1965-75 period. This number means that, for Ethiopia in 1965, a rise in per capita GDP by 10% would raise the growth rate by about 0.2% per year.

[4] The variable plotted on the vertical axis is the growth-rate net of the estimated effect of all explanatory variables aside from log(GDP) and its square. The value plotted was also normalised to make its mean value zero.

Figure 2. Growth rate versus GDP level



For the richest countries, the partial effect of log(GDP) on the growth rate is strongly negative at the margin. The largest magnitude (corresponding to the highest value of per capita GDP) is for Luxembourg in 1995—the GDP value of USD 19794 implies a marginal effect of -0.064 on the growth rate. The US in 1995 has the next largest GDP value (USD 18951) and also has an estimated marginal effect on GDP of -0.064. These values mean that an increase in per capita GDP by 10% implies a decrease in the growth rate on impact by 0.6% per year. But higher levels of GDP tend to be associated with levels of other explanatory variables (such as more schooling, lower fertility, and better maintenance of the rule of law) that have offsetting implications for growth.

Overall, the cross-country evidence shows no pattern of absolute convergence—whereby poor countries tend systematically to grow faster than rich ones—but provides strong evidence of conditional convergence. That is, except possibly at extremely low per capita product levels, a poorer country tends to grow faster for given values of the policy and other explanatory variables. The pattern of absolute convergence does not appear because poor countries systematically

have less favourable values of the determining variables other than log(GDP).

In the panel for the investment ratio in Table 1, the pattern of estimated coefficients on log(GDP) is also positive on the linear term and negative on the square. These values imply a hump-shaped relation between the investment ratio and the starting level of GDP—the relation is positive for per capita GDP below USD 5100 and then becomes negative.

2. Government consumption. The ratio of government consumption to GDP is intended to measure a set of public outlays that do not directly enhance an economy's productivity.[1] In interpreting the estimated effect on growth, it is important to note that measures of taxation are not being held constant. This omission reflects data problems in constructing accurate representations for various tax rates, such as marginal rates on labour and capital income, and so on. Because the tax side has not been held constant, the effect of a higher government consumption ratio on growth involves partly a direct impact and partly an indirect effect that involves the required increase in overall public revenues.

Table 1 indicates that the government consumption-ratio effect, G/Y, on growth is significantly negative. The coefficient estimate implies that an increase in G/Y by 10 percentage points would reduce the growth rate on impact by 1.5% per year. Figure 3 shows the partial relation between the growth rate and G/Y.

[1] The system contains as an explanatory variable the average ratio of government consumption to GDP over the period in which growth is measured. But the estimation uses a set of instrumental variables that contains prior ratios of government consumption to GDP but not the contemporaneous ratios. The standard international accounts include most public outlays for education and defence as government consumption, although these types of expenditures can reasonably be regarded as primarily investment. These two categories were deleted from the measure of government consumption used here. If considered separately, the ratio of public spending on education to GDP has a positive, but statistically insignificant, effect on economic growth. The ratio of defence outlays to GDP has roughly a zero relation with economic growth.

Figure 3. Growth rate versus government consumption

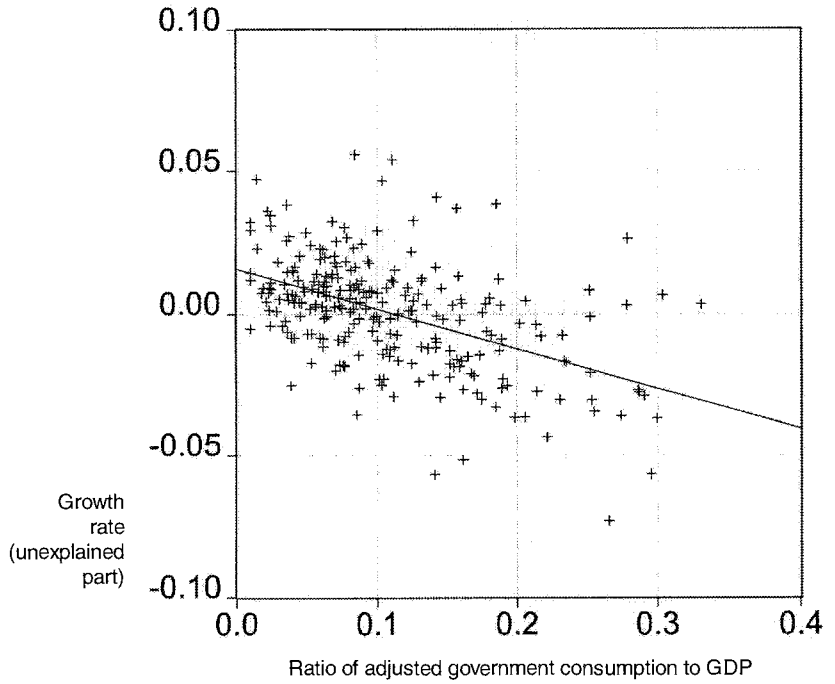


Table 1 indicates that the government consumption ratio has a significantly negative effect on the investment ratio. An increase in G/Y by 10 percentage points is estimated to lower the investment ratio by nearly three percentage points. This result suggests that depressing investment is one way in which more non-productive public spending lowers growth. But because the investment ratio is held constant in the Table 1 growth-rate panel, the estimated negative G/Y effect on growth applies for a given investment quantity. The depressing G/Y effect on the investment ratio reinforces this influence.

3. The rule of law. Many analysts believe that secure property rights and a strong legal system are central for investment and other aspects of economic activity. The empirical challenge has been to measure these concepts in a reliable way across countries and over time. Probably the best indicators available come from international consulting firms that advise clients on the attractiveness of countries as places for investments. These investors are concerned about institutional matters, such as the prevalence of law and order, the capacity of the legal system to enforce contracts, the efficiency of the bu-

reaucracy, the likelihood of government expropriation, and the extent of official corruption. Several consulting companies, including Political Risk Services (PRS in *International Country Risk Guide*) assessed these kinds of facts.[2] This source is especially useful because it covers more than 100 countries since the early 1980s. Although the data are subjective, they have the virtue of being prepared contemporaneously by local experts. Moreover, customers' willingness to pay substantial fees for this information perhaps testifies to their validity.

Among the various indicators available, the index for overall rule-of-law maintenance (also called *law and order tradition*) turns out to have the most explanatory power for economic growth and investment. PRS initially measured this index (in seven categories on a zero to six scale, with six the most favourable). The index has been converted here to a zero-to-one scale, with zero indicating the poorest maintenance of the rule of law and one the best.

To understand the scale, note that the US and most OECD countries (not counting Mexico and Turkey) had values of 1.0 for the rule-of-law index in recent years. But Belgium, France, Greece, Portugal, and Spain were downgraded from 1.0 in 1996 to 0.83 in 1997. Also rated at 1.0 in 1997 were Hungary, Kuwait, Malta, Morocco, and Singapore. (Hong Kong was downgraded upon its return to China from 1.0 in 1996 to 0.83 in 1997.)

No country had a rating of 0.0 for the rule of law in 1997, but countries rated at 0.0 in some earlier years included Ethiopia, Guyana, Haiti, Sri Lanka, Yugoslavia, and Zaire. Countries rated at 0.5 in 1997 included Algeria, Brazil, Mexico, Peru, Uruguay, South Africa, several other countries in sub-Saharan Africa, and much of Central America.

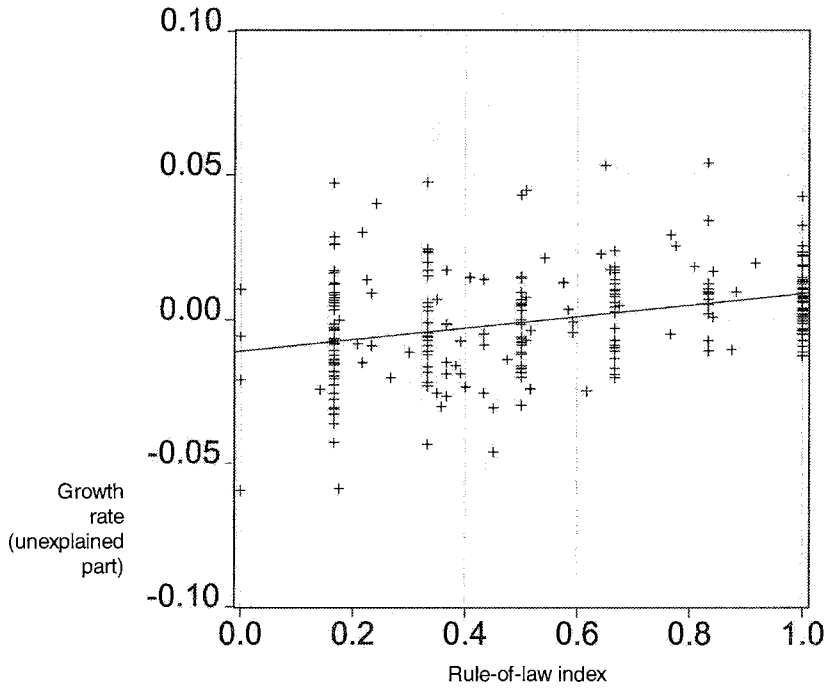
The scatter diagram in Figure 4 indicates that, for given values of the other explanatory variables, increased rule-of-law maintenance has a positive and statistically significant effect on the economic growth rate.[3] An improvement by one category among the seven

[2] Knack and Keefer (1995) introduced these data to economists. Two other consulting services that construct these types of data are Business Environmental Risk Intelligence (BERI) and Business International (now a part of the Economist Intelligence unit).

[3]The variable shown on the horizontal axis is the earliest observation available for each country for the first two equations—in most cases 1982 and, in a few cases, 1985. For the third equation, the average value of the rule-of-law index for 1985-94 is used. Since the data on the rule-of-law index begin only in 1982 or 1985, later values of this variable are allowed to influence earlier values of economic growth

used by PRS (that is, an increase in the zero-to-one index by 0.17) is estimated to raise the growth rate on impact by 0.3% per year.

Figure 4. Growth rate versus rule of law.



The results from the Table 1 investment panel show that the rule-of-law index also has a significantly positive effect on the ratio of investment to GDP. An improvement by one category in the underlying rule-of-law indicator is estimated to raise the investment ratio by about 1.1 percentage points. The stimulus to investment is one way that better rule-of-law maintenance would encourage growth. But because the investment ratio is held constant in the Table 1 growth panel, the estimated positive effect of the rule-of-law indicator on

and investment in the 1965-75 and 1975-85 periods. (For the third equation, the instrument list includes the rule-of-law value for 1985 but not for later years.) The idea here is that institutions that govern the rule of law tend to persist over time, so that the observations for 1982 or 1985 are probably good proxies for the values prevailing earlier. The significantly positive effects of the rule-of-law index on economic growth and investment still emerge if the sample is limited to the growth observations that applied after the early 1980s.

growth applies for a given investment quantity. The stimulative effect on the investment ratio reinforces this influence.

4. Democracy. Another strand of research on the role of institutions has focused on democracy, specifically on the strength of electoral rights and civil liberties. In this case, the theoretical effects on investment and growth are ambiguous. One effect, characteristic of systems of one-person/one-vote majority voting, involves the pressure to enact redistributions of income from rich to poor. These redistributions may involve land reforms and social-welfare programs. Although the direct effects on income distribution may be desirable (because they are equalising), these programs tend to compromise property rights and reduce work and investment incentives. One kind of disincentive involves transfers given to poor people. Because the amount received typically falls as the person earns more income, the recipient is motivated to remain on welfare or otherwise disengage from productive activity. The other adverse effect involves income taxes or other levies that are needed to pay for transfers. An increase in these taxes encourages the non-poor to work and invest less.

One offsetting effect is that an evening of income distribution may reduce the tendency for social unrest. Specifically, transfers to the poor may reduce incentives to engage in criminal activity, including riots and revolutions.[4] Because social unrest reduces incentives to work and invest, some amount of publicly organised income redistribution may contribute to overall economic activity. But even a dictator would be willing to engage in transfers to the extent that the decrease in social unrest was worth the cost of the transfers. So the main point is that democracy will tend to generate "excessive" transfers purely from the standpoint of maximising the economy's total output.

Although democracy has its down side, one cannot conclude that autocracy provides ideal economic incentives. One problem with dictators is that they have the power and, hence, the inclination to steal the nation's wealth. More specifically, an autocrat may find it difficult to convince people that their property will not be confiscated once investments are made. This convincing can sometimes be accomplished through reputation—that is, from a history of good behaviour—but also by relaxing to some degree the hold on power.

[4] Data are available across countries on numbers of revolutions, riots, and so on. But once the rule-of-law index is held constant, these measures of social unrest turn out to lack significant explanatory power for growth and investment.

In this respect, an expansion of democracy—viewed as a mechanism for checking the central authority's power—may enhance property rights and thereby encourage economic activity. From this perspective, democracy would encompass electoral rights and civil liberties that allow for freedom of expression, assembly, and so on.

Several researchers have provided quantitative measures of democracy. In an overview study, Alex Inkeles (1991, p. x) finds a:

> high degree of agreement produced by the classification of nations as democratic or not, even when democracy is measured in somewhat different ways by different analysts.

Gastil (1982-83 and other years) and his followers at Freedom House provide one of the most useful measures (because since 1972, it is annually and consistently available for almost all countries). This source provides separate indexes for electoral rights and civil liberties. The Freedom House concept of electoral rights uses this basic definition:

> Political rights are rights to participate meaningfully in the political process. In a democracy this means the right of all adults to vote and compete for public office, and for elected representatives to have a decisive vote on public policies (Gastil, 1986-87 edition, p. 7).

Besides the basic definition, the classification scheme rates countries (somewhat impressionistically) as less democratic if minority parties have little influence on policy.

Freedom House applies the concept of electoral rights on a subjective basis to classify countries annually into seven categories, where group one is the highest level of rights and group seven is the lowest. Gastil and his associates and followers created this classification based on an array of published and unpublished information about each country. The original ranking from one to seven was converted here to a scale from zero to one, where zero corresponds to the fewest rights (Freedom House rank seven) and one to the most rights (Freedom House rank one). The scale from zero to one corresponds to a Kenneth Bollen (1990) classification for 1960 and 1965. The Bollen index differs mainly in that its concept of democracy goes beyond electoral rights.

To fix ideas on the meaning of the zero-to-one subjective scale, note first that the US and most other OECD countries in recent years received the value 1.0, thereby being designated as full representative democracies. Dictatorships that received the value 0.0 in 1996 included China, Indonesia, Iraq, Saudi Arabia, Syria, and several countries in sub-Saharan Africa. Places that were rated in 1996 at 0.5—halfway along between dictatorship and democracy—included Colombia, Ethiopia, Haiti, Jordan, Malaysia, Mexico, Nicaragua, Pakistan, Paraguay, Peru, Senegal, Singapore, Turkey, and Uganda.

The Freedom House index of civil liberties is constructed in a similar way. The definition here is:

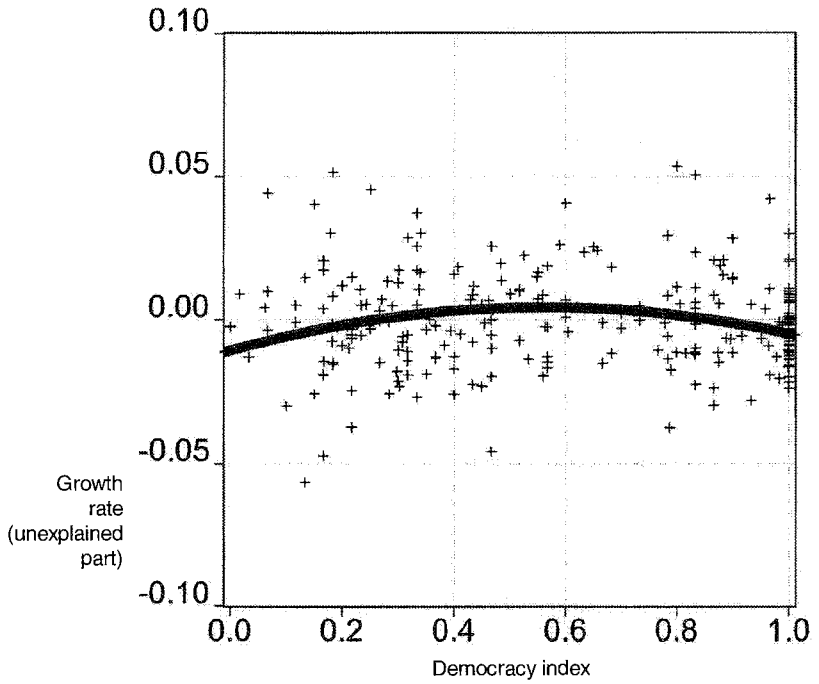
> ... civil liberties are rights to free expression, to organise or demonstrate, as well as rights to a degree of autonomy such as is provided by freedom of religion, education, travel, and other personal rights (Gastil, 1986-87 edition, p. 7).

In practice, the civil liberties indicator is extremely highly correlated with that for electoral rights. So for practical purposes, it makes little difference in the analysis of growth and investment whether one uses the index for electoral rights or the one for civil liberties. The empirical work discussed here uses the index of electoral rights and sometimes refers to this indicator as simply a measure of democracy.

With the other independent variables in Table 1 held constant, the overall relation between the growth rate and the democracy index turns out to be close to zero. The Table 1 results suggest a non-linear relationship—positive on the democracy level and negative on the square of democracy. But because a Wald test for the joint significance of the two democracy variables has a p-value of 0.18, the statistical support for this relationship is weak.

The fitted relation between growth and democracy is shown in Figure 5. As the Wald test suggested, the overall relation between growth and democracy is weak. In particular, there are examples of dictatorships (values of electoral rights near zero) with high and low rates of growth and similarly for democracies (values of democracy near one). Analogous findings apply to the democracy effect on the investment ratio, as shown in Table 1.

Figure 5. Growth rate versus democracy.



Do not interpret the results to mean that dictatorship is desirable from an economic-performance standpoint. There are examples of autocrats (such as Pinochet in Chile, Fujimori in Peru, the Shah in Iran, and Lee and several others in East Asia) who produced good growth outcomes. But other examples exist (including Marcos in the Philippines, Mao in China, Mobutu and numerous other despots in Africa, and many others in South America and eastern Europe) who delivered poor growth outcomes. Thus, the findings also do not support the oft-mentioned idea that democracy is necessary for growth.

5. The inflation rate. Table 1 shows a significantly negative inflation effect (based on consumer price indexes) on the economic-growth rate.[1] The estimated coefficient implies that an increase in the average

[1] Due to concern about reverse causation (lower growth causing higher inflation), the panel estimation in Table 1 does not contain contemporaneous or lagged inflation values or money growth in the instrument set. Rather, the system includes dummy variables for prior colonial history as instruments. These dummy variables have substantial predictive content for inflation. (An attempt to use central-bank independence as an instrument failed because this variable turned out to lack predictive content for inflation.) The estimated coefficient on the inflation rate has a

inflation rate by 10% per year would lower the growth rate on impact by 0.4% per year.

Figure 6 shows the partial relation between growth and inflation. In figure 6a, which includes the full range of inflation, the estimated inflation effect is significantly negative. But the observations of extreme inflation appear to drive the relation. (Note that 1.0 on the horizontal axis signifies inflation at the continuously compounded rate of 100% per year.)

Figure 6a. Growth rate versus inflation rate.

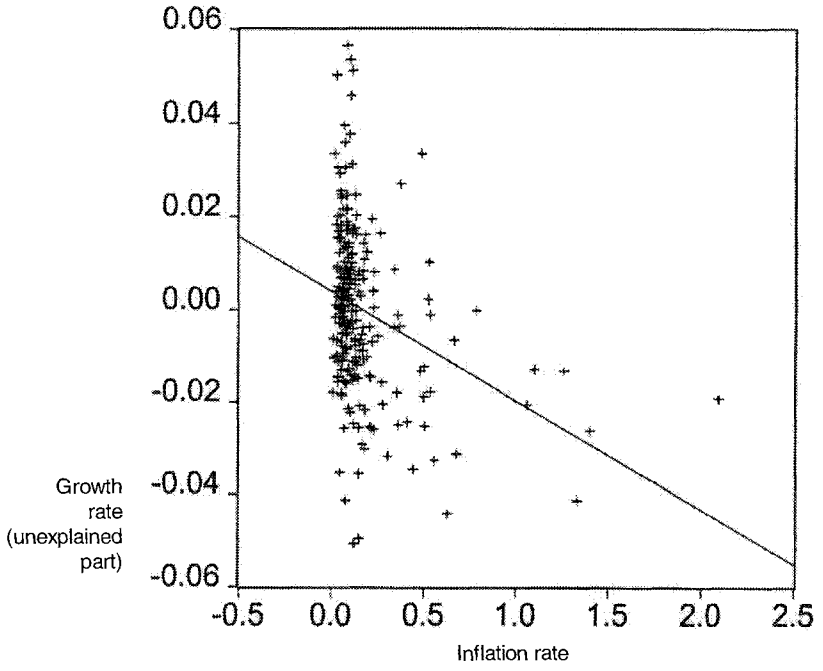


Figure 6b shows that the growth and inflation relationship is only weakly negative (and not statistically significant) if one considers only moderate inflation, up to rates of 20% per year. Figure 6c shows that a negative relationship applies for higher inflation rates. Despite these apparent differences in inflation effects at low and high levels, a Wald test accepts the hypothesis that the inflation effect on growth in the low inflation range (6b) is the same as that in the high range (6c). So there is no indication in the data over any range of a positive

smaller magnitude but is still significantly negative if lagged inflation is included with the instruments.

Figure 6b. Growth and inflation relationship weakly negative.

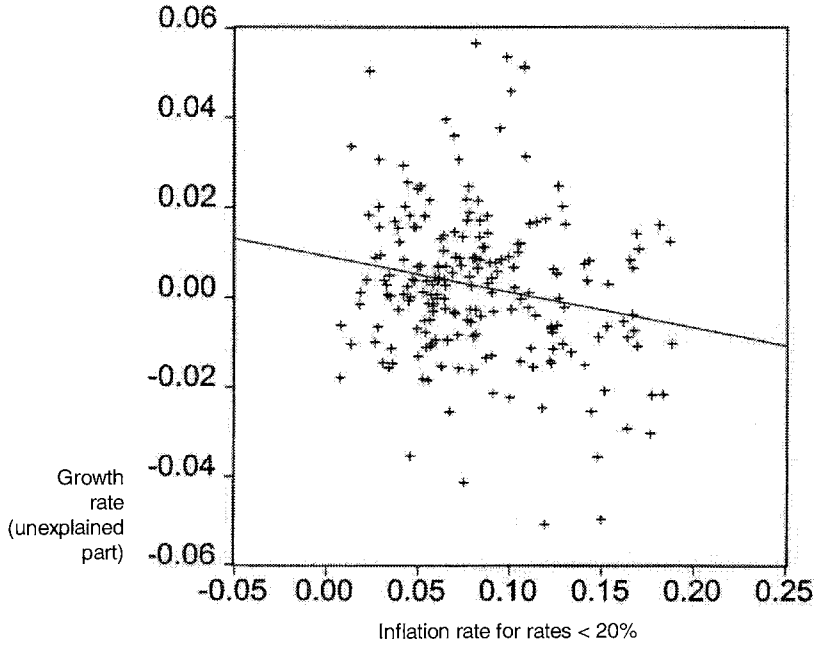
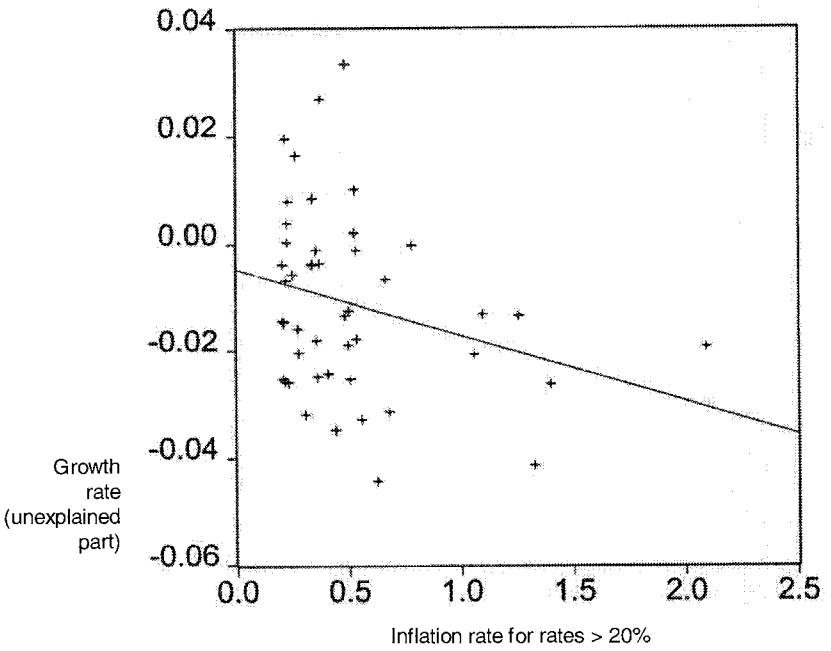


Figure 6c. A negative relationship applies.



inflation effect on growth. That is, for growth averaged over 10 years, there is no sign that an economy must accept more inflation to achieve better real outcomes.

Table 1 shows that inflation also has a negative effect on the investment ratio. This depressing effect on investment would reinforce the direct negative effect on growth that was already discussed.

6. Education. Governments typically have strong direct involvement in the financing and provision of schooling at various levels. Hence, public policies in these areas have major effects on a country's human-capital accumulation. One measure of this schooling capital is the average years of attainment, as constructed by Barro and Lee (1997). These data are classified by sex and age (for persons ages 15 and above and ages 25 and above) and by levels of education (no school, partial and complete primary, partial and complete secondary, and partial and complete higher).

In growth-accounting exercises, the growth rate would be related to the change in human capital (say, the change in years of schooling) over the sample period. But my approach is to think of changes in capital inputs, including human capital, as jointly determined with economic growth. These variables all depend on (hopefully exogenous) policy variables and national characteristics and on initial values of state variables, including stocks of human and physical capital.

For a given initial per capita GDP level, a higher initial stock of human capital signifies a higher ratio of human to physical capital. This higher ratio tends to generate higher economic growth through at least two channels. First, more human capital facilitates the absorption of superior technologies from leading countries. This channel is likely to be especially important for schooling at the secondary and higher levels. Second, human capital tends to be more difficult to adjust than physical capital. So a country that starts with a high ratio of human to physical capital—such as in the aftermath of a war that destroys primarily physical capital—tends to grow rapidly by adjusting upward the quantity of physical capital.

Table 1 shows that the average years of school attainment at the secondary and higher levels, for males ages 25 and above, has a positive and significant effect on the subsequent economic-growth rate.[1] The estimated coefficient implies than an additional year of schooling raises the growth rate on impact by 0.7% per year. As already men-

[1] The results are basically the same if the years of attainment apply to persons ages 15 and above.

tioned, one interpretation of this effect is that a work force educated at the secondary and higher levels facilitates the absorption of technologies from more advanced foreign countries.

Female schooling at the secondary and higher levels turns out not to have significant explanatory power for growth—if this variable is added to the growth panel, its estimated coefficient is -0.0044 (s.e.=0.0040). But note that female education has a strong negative effect on fertility rates, and the fertility variable is already held constant in the growth panel. If fertility is not held constant, then female schooling appears somewhat more important for growth (with a coefficient that is roughly zero, rather than negative). One possible explanation for the weak role of female schooling in the growth panel is that many countries follow discriminatory practices that prevent the efficient exploitation of females in the formal labour market. Given these practices, it is not surprising that more resources devoted to female education would not show up as enhanced growth.

Years of attainment of males or females at the primary level turn out to be insignificant for growth. The special importance of schooling at the secondary and higher levels supports the idea that education affects growth particularly by facilitating the absorption of new technologies, which are likely to be complementary with labour educated to these higher levels. But primary schooling is critical as a prerequisite for secondary schooling.

Table 1 indicates that years of schooling (for males at the secondary and higher levels) are insignificantly related to the investment ratio. Hence, the linkage between human capital and growth does not involve an expansion in the intensity of physical capital. This result is inconsistent with the effects mentioned before involving the ratio of human to physical capital.

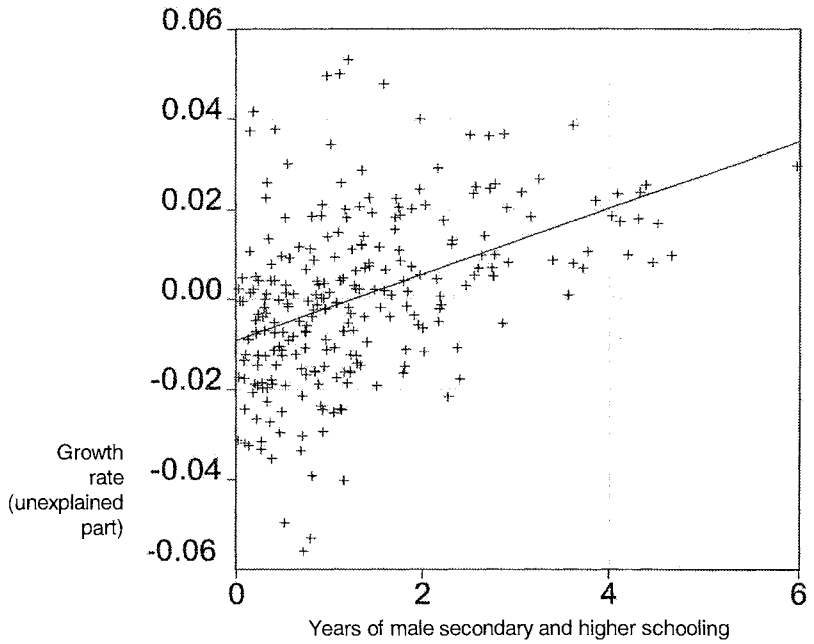
Many researchers argue that the schooling quality is more important than the quantity, measured, for example, by years of attainment. Barro and Lee (1997) discuss the available cross-country aggregate measures of education quality. Hanushek and Kim (1995) find that scores on international examinations—an indicator of schooling-capital quality—matters more than years of attainment for subsequent economic growth. My preliminary results support this finding.

Information on test scores (science, reading, and mathematics) is available for 51 countries in my sample. One drawback of these data, however, is that the observations apply to different years and are most plentiful in the 1990s. In any event, the available data were used

to construct a single cross-section of test scores for the 51 countries. If this variable is added to the panel system for growth, then the estimated coefficient on the test-score variable is highly significant—0.101 (s.e.=0.027).[2] The male secondary and higher schooling variable remains significant, but the estimated coefficient falls by about one-half from the value shown in Table 1—the estimate is now 0.0035 (s.e.=0.0015). So there is a suggestion that the quality and quantity of schooling both matter for growth; see also Figure 7, which applies when the test scores variable is omitted from the system.

The results just described result if the cross-sectional test-score variable is included in the instrument list for each time period. One problem with this procedure is that later values of test scores are allowed, in some cases, to influence prior values of growth rates. But the results are nearly the same if the instrument list omits the test-score variable and includes instead only prior values of variables that have predictive content for test scores.

Figure 7. Growth rate versus schooling.



[2] This system has 40 observations for 1965-75, 43 for 1975-85, and 43 for 1985-95. There is some indication that science test scores have the most explanatory power for growth, although it is difficult to separate this variable statistically from mathematics scores. For given science scores, reading scores have roughly a zero relation with economic growth.

These variables are the total years of schooling of the adult population (a proxy for parents' education) and pupil-teacher ratios at the primary and secondary levels. Results are also similar if prior values of school dropout rates, which are inversely related to test scores, are added as instruments.

7. Fertility rate. Table 1 shows that economic growth is significantly negatively related to the total fertility rate. So the choice to have more children per adult—and hence, in the long run to have a higher rate of population growth—comes at the expense of growth in output per person. Note that this relation applies when variables such as per capita GDP and education are held constant. These variables are substantially negatively related to the fertility rate. Thus, the estimated coefficient on the fertility variable likely isolates differing underlying preferences across countries on family size, rather than effects related to the economic-development level. Figure 8 shows the partial relation between the growth rate and the fertility rate.

Figure 8. Growth rate versus fertility rate.

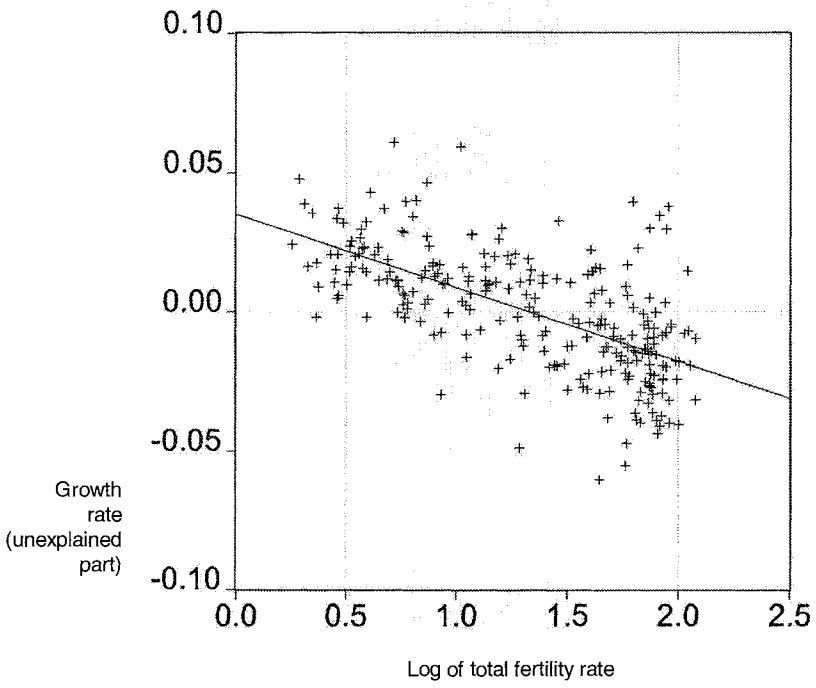


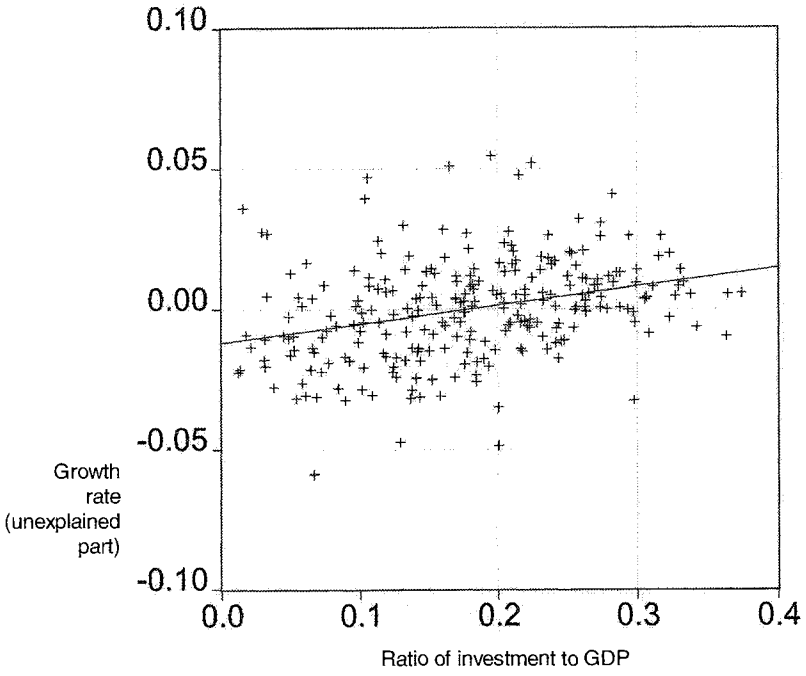
Table 1 also reveals a significant negative relation between the investment ratio and the fertility rate. This relation can be interpreted as an indication that numbers of children is a form of saving that is a substitute for other types of saving (which support physical investment). The negative fertility-rate effect on the investment ratio reinforces the direct, inverse, fertility effect on growth.

8. Investment ratio. Table 1 shows that the growth rate depends positively on the investment ratio. This effect applies for given values of policy and other variables, as already discussed, which affect the investment ratio. For example, an improvement in the rule of law raises investment and also raises growth for a given amount of investment. Thus, the estimated coefficient of the investment ratio in the growth panel—0.059 (s.e.=0.022)—is interpretable as an effect from a greater propensity to invest for given values of the policy and other variables. For example, the effect would relate to the investment ratio being higher because of a greater propensity to save (which would affect domestic investment to the extent that an economy is not fully open) or because of some unmeasured policies that influence investment. Recall also that the instrument list for the estimation includes earlier values of the investment ratio but not values that are contemporaneous with the growth rate. So there is some reason to believe that the estimated relation reflects effects of greater investment on the growth rate, rather than a reverse effect from higher growth (and the accompanying better investment opportunities) on the investment ratio.

Figure 9 shows the partial relation between the growth rate and the investment ratio. The implied effect—with an estimated coefficient of 0.059 in Table 1—suggests that an economy's real return rate to investment is reasonable but not astronomical.

9. The terms of trade. Table 1 indicates that improvements in the terms of trade (a higher growth rate of the ratio of export prices to import prices) enhance economic growth, but are insignificantly related to the investment ratio. The measurement of growth rates in terms of changes in real GDP means that this relation is not a mechanical one. That is, if employment and production patterns are unchanged, then an improvement in the terms of trade would raise real income and probably real consumption but would have a zero effect on real GDP. The positive impact of an improvement in the terms of trade on real GDP therefore reflects increases in factor employments or productivity.

Figure 9. Growth rate versus investment.



2.3. Growth-rate forecasts

The system estimated over the 1965-95 period can be adapted to generate growth forecasts for the period after 1995. These forecasts are based on the latest available observations on the variables that have been discussed. For most countries and variables, the data are for 1996. The figures on schooling, government consumption, and investment are for the early 1990s. In most cases (aside from the growth rate of the terms of trade), the historical relationships indicate that these latest observations on the explanatory variables would have substantial predictive power for the sample averages of these variables over the 1996-2006 forecast period.

The growth-rate panel discussed in Table 1 was reestimated (by the seemingly unrelated method) using only prior values of the regressors. For example, for 1965-75, this system has as explanatory variables log(GDP) and its square for 1965, the government consumption ratio for 1960-64, the earliest available value for the rule-of-law variable (for 1982 or 1985), democracy and its square in 1965, inflation for 1960-65, schooling in 1965, fertility in 1965, and the in-

vestment ratio for 1960-64. Table 2 shows the predicted per capita growth-rate values for 1996-2006, generated from this system for the 88 countries with the necessary data.[3] It also shows actual growth rates from 1960 to 1995.

Table 2. Growth-rate forecasts.

Country	Growth forecast, 1996-2006	Growth rate, 1960-95
Algeria	0.015	0.011
Botswana	-0.013	0.053 (6)
Cameroon	-0.001	0.012
Congo (Republic)	-0.038	0.015
Egypt	0.029	0.026
Gambia	-0.007	0.005
Ghana	0.019	0.002
Kenya	0.013	0.008
Malawi	-0.005	0.007
Mali	0.006	0.000
Niger	-0.021	-0.004
Senegal	0.011	0.001
Sierra Leone	0.007	-0.034*
South Africa	0.009	0.010
Sudan	0.005	0.008
Togo	0.007	0.010
Tunisia	0.030	0.030
Uganda	0.014	0.003
Zaire (Dem. Rep. of Congo)	-0.016	-0.022
Zambia	0.005	-0.016
Zimbabwe	0.021	0.003
Canada	0.007	0.025
Costa Rica	0.020	0.018
Dominican Republic	0.041 (5)	0.020
El Salvador	0.016	0.012
Guatemala	0.021	0.009
Haiti	0.021	-0.016
Honduras	0.029	0.009
Jamaica	0.042 (4)	0.010
Mexico	0.019	0.020
Nicaragua	0.020	-0.008
Panama	0.028	0.022
Trinidad	0.009	0.010
US	0.011	0.019
Argentina	0.032	0.007

[3] The constant term used here is the one that applies to the 1985-95 period. For China, Hungary, and Poland, rough estimates were used for the government consumption ratio.

Table 2. continued..

Country	Growth forecast, 1996-2006	Growth rate, 1960-95
Bolivia	0.025	0.013
Brazil	0.021	0.025
Chile	0.030	0.020
Colombia	0.022	0.023
Ecuador	0.037	0.020
Guyana	0.039 (9)	-0.002
Paraguay	0.029	0.018
Peru	0.040 (8)	0.008
Uruguay	0.014	0.008
Venezuela	0.011	0.000
Bangladesh	-0.012	0.014
China	0.053 (1)	0.039
Hong Kong	0.012	0.059 (3)
India	0.023	0.019
Indonesia	0.027	0.041
Iran	0.033	0.007
Israel	0.010	0.032
Japan	0.018	0.047 (8)
Jordan	0.029	0.029
South Korea	0.042 (3)	0.066 (1)
Malaysia	0.019	0.045 (9)
Pakistan	0.031	0.025
Philippines	0.038	0.013
Singapore	0.021	0.056 (4)
Sri Lanka	0.045 (2)	0.019
Syria	0.022	0.032
Taiwan	0.019	0.061 (2)
Thailand	0.037	0.048 (7)
Austria	0.025	0.027
Belgium	0.008	0.026
Cyprus	0.014	0.044 (10)
Denmark	-0.010	0.023
Finland	-0.010	0.026
France	-0.002	0.026
Germany	-0.002	0.024
Greece	0.040 (7)	0.035
Hungary	0.039 (10)	0.017*
Iceland	-0.013	0.028
Ireland	0.007	0.037
Italy	0.015	0.030
Malta	0.006	0.053 (5)
Netherlands	0.014	0.024

Table 2. continued..

Country	Growth forecast, 1996-2006	Growth rate, 1960-95
Norway	-0.016	0.032
Poland	0.041 (6)	0.014*
Portugal	0.010	0.042
Spain	0.024	0.034
Sweden	0.000	0.019
Switzerland	0.016	0.015
Turkey	0.032	0.026
UK	0.001	0.020
Australia	0.001	0.021
New Zealand	0.013	0.013
Papua New Guinea	0.004	0.012

Notes: *1970-95. The growth rate is the annual value for per capita real GDP. The forecasted value for 1996-2006 comes from the framework described in the text. The explanatory variables used for most countries are the 1996 value of GDP, 1990 values of school attainment, 1992 value of the government consumption ratio, 1997 value of rule of law, 1996 value of democracy, 1996 value of fertility, 1996-97 value of inflation, and 1992 value of the investment ratio. Earlier values were used in some cases when the later data were unavailable. The numbers shown in parentheses indicate the highest 10 values in each column.

For all 110 countries with the data on GDP, the average growth rate of per capita GDP from 1960 to 1995 was 1.8% per year. Some regional average growth rates were 4.3% for 11 east Asian countries, 2.6% for 24 OECD countries, 1.2% for 24 Latin American countries, and 0.7% for 37 sub-Saharan African countries.

The group of high-growing countries was, as is well known, dominated by east Asian countries—South Korea first at 6.6%, Taiwan second at 6.1%, Hong Kong third at 5.9%, Singapore fourth at 5.6%, Thailand seventh at 4.8%, Japan eighth at 4.7%, and Malaysia ninth at 4.5%. The other countries in the top-10 list were Malta (fifth at 5.3%), Botswana (sixth at 5.3%), and Cyprus (tenth at 4.4%).

For the forecasts of growth from 1996 to 2006, the average value for 88 countries with the necessary data is 1.6% per year.[4] Regional averages are 2.7% for 11 east Asian countries, 0.8% for 23 OECD countries, 2.6% for 22 Latin American countries, and 0.1% for 18 sub-Saharan African countries. The reduction in projected perform-

[4] Note that the constant term is, by assumption, the one applying for the 1985-95 period.

ance for the east Asian and OECD countries—compared with actual growth rates from 1960 to 1995—reflects especially the workings of the convergence force. These places are now pretty rich on average, even in comparison with years of schooling and the values of the other independent variables. The projected increase of growth in Latin America particularly reflects improvements in policy variables, including reduced inflation and better maintenance of the rule of law.

In the list of projected high growers, east Asian countries are much less prominent than before—the only ones appearing on the top-10 list are China (first at 5.3%) and South Korea (third at 4.2%). The transition economies of Poland (sixth at 4.1%) and Hungary (tenth at 3.9%) are on the list, and other formerly non-market economies would likely be present if data were available. The other high-growth forecasts are mixed geographically, including Sri Lanka, Trinidad, Dominican Republic, Greece (the only OECD representative), Peru, and Guyana.

One way to understand the pattern of forecasts is to break down the growth prediction (expressed as a deviation from the sample mean) into contributions from each of the explanatory variables. These variables, each expressed as deviations from their respective sample means, are log(GDP) and its square, the government consumption ratio, the rule of law, democracy and its square, the inflation rate, years of schooling, the fertility rate, and the investment ratio. For instance, a relatively high value of log(GDP) contributes a negative amount to the growth prediction. This effect is the conditional-convergence force. Relatively good policy-variable values—low government consumption, high rule of law, and low inflation—contribute positively to the growth forecast. Similarly, the growth contribution is positive for high years of schooling, low fertility, and high investment. The democracy variable has a non-linear effect, but the overall magnitudes here are small. Table 3 shows the values of the contributions for the explanatory variables that turned out to be most important—log(GDP) and its square, schooling, government consumption, the rule of law, and the fertility rate.

Table 3. Contributions to growth-rate predictions.

Country	Predicted growth rate	Log(GDP) contribu-tion	Schooling contribu-tion	Govt. con. contribu-tion	Rule-of-law contribu-tion	Fertility contribu-tion
Algeria	-.001	.022	-.006	-.005	-.005	-.006
Botswana	-.029	.015	-.012	-.019	-.001	-.012
Cameroon	-.017	.035	-.010	-.010	-.005	-.019
Congo (Rep.)	-.054	.028	.001	-.045	-.005	-.021
Egypt	.013	.027	.000	-.004	-.001	-.005
Gambia	-.023	.035	-.011	-.024	.002	-.018
Ghana	.003	.035	-.004	-.006	-.005	-.016
Kenya	-.002	.035	-.011	-.004	-.001	-.014
Malawi	-.021	.034	-.012	-.016	-.001	-.024
Mali	-.010	.034	-.014	.000	-.005	-.025
Niger	-.037	.032	-.014	-.012	-.008	-.027
Senegal	-.005	.035	-.011	-.005	-.005	-.020
Sierra Leone	-.009	.035	-.011	-.004	-.005	-.024
South Africa	-.006	.017	-.006	-.007	-.005	-.001
Sudan	-.011	.035	-.010	-.002	-.008	-.015
Togo	-.008	.034	-.006	-.006	-.005	-.022
Tunisia	.014	.015	-.005	.003	.002	.000
Uganda	-.002	.035	-.014	.001	-.001	-.024
Zaire	-.032	.019	-.010	.001	-.008	-.023
Zambia	-.011	.034	-.008	-.015	-.001	-.020
Zimbabwe	.005	.034	-.012	-.008	-.001	-.009
Canada	-.009	-.058	.019	.011	.006	.014
Costa Rica	.004	.011	-.003	-.001	-.001	.000
Dom. Rep.	.026	.022	-.005	.007	-.001	-.003
El Salvador	.000	.026	-.007	-.009	-.005	-.006
Guatemala	.005	.025	-.010	.007	-.005	-.014
Haiti	.005	.034	-.010	-.004	-.005	-.012
Honduras	.013	.032	-.008	.004	-.005	-.013
Jamaica	.026	.023	-.005	.007	-.005	.005
Mexico	.003	-.004	.001	.009	-.005	.001
Nicaragua	.004	.034	-.008	-.012	-.001	-.010
Panama	.012	.014	.006	-.008	-.005	.002
Trinidad	-.007	-.017	.000	.007	-.001	.008
US	-.005	-.064	.034	.013	.006	.008
Argentina	.016	-.003	-.001	.015	.002	.001
Bolivia	.009	.029	-.001	.000	-.005	-.013
Brazil	.005	.008	-.007	.005	-.005	.004
Chile	.015	-.005	.000	.008	.002	.006
Colombia	.006	.012	-.005	.005	-.008	.001
Ecuador	.021	.019	.002	.005	-.001	-.003
Guyana	.023	.032	-.006	-.007	-.001	.005

Note: The predicted growth rate for 1996-2006 is expressed as a deviation from the sample mean (which was 0.016). The other columns show the contribution to the growth-rate prediction from the indicated independent variable. The contribution equals the respective coefficient estimate multiplied by the value of the independent variable (expressed as a deviation from the sample mean).

Table 3. continued...

Country	Predicted growth rate	Log(GDP) contribu-tion	Schooling contribu-tion	Govt. con. contribu-tion	Rule of law contribu-tion	Fertility contribu-tion
Paraguay	.013	.026	-.006	.000	-.001	-.010
Peru	.024	.021	.000	.006	-.005	-.003
Uruguay	-.002	-.001	.001	.001	-.005	.007
Venezuela	-.005	-.005	-.004	.007	-.001	-.002
Bangladesh	-.028	.031	-.007	-.040	-.005	-.005
China	.037	.024	.002	.002	.002	.011
Hong Kong	-.003	-.061	.016	.013	.002	.023
India	.007	.031	-.004	-.016	-.001	-.003
Indonesia	.012	.021	-.008	.003	-.001	.002
Iran	.017	.012	-.003	.014	.002	-.009
Israel	-.006	-.031	.007	.015	.002	.002
Japan	.003	-.052	.016	.012	.006	.019
Jordan	.014	.016	.008	.000	-.001	-.013
South Korea	.026	-.026	.021	.015	-.001	.013
Malaysia	.003	-.013	.002	.010	.002	-.005
Pakistan	.015	.031	-.002	.002	-.001	-.017
Philippines	.022	.029	.000	.001	-.001	-.008
Singapore	.005	-.036	.000	.014	.006	.014
Sri Lanka	.029	.023	.001	-.002	-.001	.006
Syria	.006	.004	.001	.015	.002	-.010
Taiwan	.003	-.033	.012	.010	-.001	.012
Thailand	.021	.000	-.006	.006	.002	.012
Austria	.009	-.043	.021	.007	.006	.019
Belgium	-.008	-.045	.008	.012	.002	.016
Cyprus	-.001	-.025	.010	.005	.002	.008
Denmark	-.026	-.051	.009	.000	.006	.012
Finland	-.025	-.044	.000	.002	.006	.012
France	-.017	-.047	.007	.008	.002	.013
Germany	-.018	-.049	-.002	.006	.006	.022
Greece	.024	-.012	.007	.009	.002	.020
Hungary	.023	.001	-.002	.002	.006	.018
Iceland	-.029	-.044	.008	-.005	.006	.008
Ireland	-.009	-.040	.007	.009	.006	.011
Italy	-.001	-.042	.006	.006	.006	.023
Malta	-.010	-.020	-.002	-.004	.006	.012
Netherlands	-.002	-.046	.012	.012	.006	.017
Norway	-.032	-.060	.008	.005	.006	.011
Poland	.025	.007	.001	.002	.002	.015
Portugal	-.006	-.018	-.004	-.002	.002	.019
Spain	.008	-.029	.005	.007	.002	.023
Sweden	-.016	-.048	.017	-.002	.006	.013
Switzerland	.000	-.051	.016	.012	.006	.017
Turkey	.016	.009	-.005	.011	-.001	.002
UK	-.016	-.045	.007	.006	.006	.014
Australia	-.015	-.055	.015	.008	.006	.012
New Zealand	-.003	-.039	.016	.006	.006	.009
Papua N. G.	-.012	.028	-.012	-.009	-.005	-.015

As an example, for the US, the extremely high value of log(GDP) contributes -0.064 to the growth forecast because of the large convergence effect. But this negative contribution is offset by positive effects from high years of schooling (0.034), low government consumption (0.013), strong rule of law (0.006), and low fertility (0.008). So the US per capita growth-rate forecast of 0.011 is only 0.005 below the sample mean of 0.016. For some other OECD countries (Denmark, Finland, France, Germany, Iceland, Norway, and Sweden), the offset to the negative convergence force is not as great, and the forecasted per capita growth rates are zero or negative. For a transition economy such as China, the contribution from log(GDP) is positive (0.024), and the reasonably good values of the other explanatory variables reinforce this effect.

One way to assess the likely reliability of the growth projections is to use the data up to 1985 to make forecasts for 1985-95. These within-sample projections can be compared with observed growth rates for this 10-year period. To perform this procedure, the growth-rate panel was reestimated over the two periods 1965-75 and 1975-85, that is, the period 1985-95 was excluded from this system. As with the projections discussed before, the equations included only prior values of the regressors. The resulting coefficient estimates (from the seemingly unrelated technique) turn out to be basically similar to those generated from the three-period panel.[5]

Table 4 shows the resulting projections of growth rates for 1985-95 along with the actual values. For the 88 countries that have data on projected and actual values, the correlation is 0.56, corresponding to a prediction R^2 of 0.31. In contrast, the R^2 value for the 1985-95 period is 0.46 in the three-period estimation based only on lagged variables.[6] This better fit emerges because the observations for 1985-

[5] But a Wald test of equality for the coefficients of all 10 explanatory variables (not including the constant term) for the first two periods versus the third period has a p-value for rejection of only 0.003.

[6] The fit would also be expected to improve with knowledge of the contemporaneous values of the regressors, rather than just the lagged values. But the R^2 value for 1985-95 in the system in Table 1 that includes contemporaneous values of the independent variables is only 0.42. This result is not precisely comparable to those from the systems with lagged variables, which were estimated by the seemingly unrelated technique, because the system in Table 1 was estimated by instrumental variables. If this system is estimated by the seemingly unrelated method, then the R^2 value for the third period is 0.46. If the system is fit by ordinary least squares, then the value is 0.49.

Table 4. Growth rates for 1985-95.

Country	Growth rate, 1985-95	Predicted growth rate
Algeria	-0.018	0.006
Botswana	0.037	0.008
Cameroon	-0.043	0.014
Congo (Republic)	-0.035	-0.021
Egypt	0.004	0.021
Gambia	-0.007	0.000
Ghana	0.020	-0.005
Kenya	0.008	0.018
Liberia	–	0.006
Malawi	-0.005	-0.004
Mali	-0.001	0.005
Niger	-0.020	0.003
Senegal	-0.008	0.003
Sierra Leone	-0.038	-0.003
South Africa	-0.007	0.008
Sudan	0.015	0.008
Togo	-0.021	0.008
Tunisia	0.015	0.020
Uganda	0.019	0.001
Zaire	-0.068	-0.006
Zambia	-0.038	-0.012
Zimbabwe	-0.012	0.022
Canada	0.011	0.008
Costa Rica	0.021	0.011
Dominican Republic	0.013	0.026
El Salvador	0.017	0.001
Guatemala	0.008	0.013
Haiti	-0.053	0.004
Honduras	0.002	0.018
Jamaica	0.014	0.026
Mexico	0.001	0.008
Nicaragua	-0.040	0.011
Panama	-0.002	0.005
Trinidad	-0.021	-0.006
US	0.013	0.019
Argentina	0.006	0.009

Note: The growth rate is for per capita GDP from 1985 to 1995. The predicted growth rate is the forecast based on data through 1985.

Table 4. continued...

Country	Growth rate, 1985-95	Predicted growth rate
Bolivia	0.001	0.001
Brazil	0.006	0.021
Chile	0.050	0.034
Colombia	0.024	0.017
Ecuador	0.000	0.028
Guyana	0.017	0.018
Paraguay	0.005	0.023
Peru	0.004	0.023
Uruguay	0.029	0.022
Venezuela	0.002	0.006
Bangladesh	0.025	-0.013
China	0.057	0.049
Hong Kong	0.053	0.030
India	0.034	0.013
Indonesia	0.047	0.031
Iran	-0.008	0.009
Iraq	–	-0.006
Israel	0.026	0.007
Japan	0.025	0.017
Jordan	-0.012	0.017
South Korea	0.077	0.065
Kuwait	–	-0.015
Malaysia	0.052	0.040
Pakistan	0.019	0.027
Philippines	0.013	0.019
Singapore	0.032	0.032
Sri Lanka	0.018	0.032
Syria	0.011	0.015
Taiwan	0.067	0.052
Thailand	0.072	0.032
Austria	0.018	0.028
Belgium	0.020	0.015
Cyprus	0.039	0.014
Denmark	0.015	-0.007
Finland	0.009	0.003
France	0.016	0.008
Germany	0.018	-0.011
Greece	0.013	0.029
Hungary	-0.004	0.033
Iceland	0.007	-0.008
Ireland	0.050	0.015
Italy	0.019	0.009

Table 4. continued...

Country	Growth rate, 1985-95	Predicted growth rate
Malta	0.049	0.006
Netherlands	0.019	0.020
Norway	0.020	-0.003
Poland	0.000	0.032
Portugal	0.046	0.023
Spain	0.030	0.020
Sweden	0.008	0.000
Switzerland	0.006	0.016
Turkey	0.026	0.029
UK	0.020	-0.008
Yugoslavia	–	0.023
Australia	0.017	0.012
New Zealand	0.008	0.017
Papua New Guinea	0.015	0.007

1995 were allowed to influence the estimation of the coefficients in the three-period setting. In any event, the conclusion is that the empirical growth framework has substantial predictive content for growth rates but that substantial prediction errors remain.

2.4. Other policy influences on growth and investment

1. Public debt. The results described so far for traditional fiscal and monetary policy involve government consumption and inflation. The choice of public financing between current and future taxation (or, equivalently, between taxes and public borrowing) is often thought also to matter for economic growth. In a closed economy, the predicted effect is that more public debt would depress national saving and lead thereby to lower growth. This effect would arise for past budget deficits, as reflected in current debt levels, and also for prospective future borrowing. In an open economy, foreign borrowing mitigates the predicted effects of public debt on domestic investment and growth. But the effects still apply to the extent that international capital markets are imperfect or that the home economy is large enough to matter for world aggregates.

To assess the effects of public debt on economic growth and investment, I use a recently constructed data set on ratios of consolidated central government debt to GDP. The underlying data come from IMF publications and other country sources. The figures refer

to five-year averages over the 1960 to 1994 period and are available for a subset of the observations considered before.

If the debt-GDP ratio is added to the system described in Table 1, then the estimated coefficient of this new variable is -0.0045 (s.e.=0.0034).[7] Hence, the effect is negative but not statistically significant. Recall, however, that this system holds constant the investment ratio, and the usual view is that more public debt depresses growth by lowering investment. In the system for the investment ratio, the estimated coefficient of the debt-GDP ratio is 0.0077 (s.e.=0.0100). Hence, there is no indication that more public debt depresses investment.

From the standpoint of a supporter of Ricardian equivalence—whereby the choice between taxes and public debt does not matter for much—these cross-country results must be gratifying. But after so much effort was expended in the construction of this new data set on government debt, it would have been nice to obtain stronger findings. At this point, the conclusion seems to be that ratios of public debt to GDP matter little for an economy's subsequent rates of economic growth and investment.

2. Labour market restrictions. Labour market restrictions imposed by governments are often thought to underlie the sluggish recent performance of many countries in western Europe. The public interventions include mandated levels of wages and benefits, restrictions on labour turnover, and encouragement of collective bargaining. The assessment of the effects of these kinds of policies for a broad sample of countries has been hindered by lack of good data. To get a rough idea of whether these sorts of restrictions matter a lot for growth, I used a rough proxy for the extent of these restrictions.

The approach is based on the labour-standards conventions adopted by the International Labour Organisation (ILO).[8] Once ratified by an individual member state (which includes most countries other than Taiwan and Hong Kong), a labour standard is supposed to be binding in terms of international law. Since its inception in

[7] The system includes the average ratio of debt to GDP over each period. The instrument lists include the average debt-GDP ratio over the five-year earlier period. For example, the 1965-75 growth-rate equation includes as an independent variable the average of the debt-GDP ratio from 1965 to 1975 and includes as an instrument the average of this ratio from 1960 to 1964.

[8] Rodrik (1996) used these measures.

1919, the ILO conference has adopted 174 conventions.[9] Many of these provisions are not very controversial, covering matters such as elimination of forced labour, freedom of association, and discrimination. Others are more directly related to the kinds of labour market interventions that would hinder economic performance.

For present purposes, I consider country ratifications of four of the ILO conventions that seem to relate closely to intervention into labour markets:

Number	Description	Adopted in ...
131	Minimum-wage fixing	1970
158	Restrictions on termination of employment	1982
154	Promotion of collective bargaining	1981
100	Equal pay for men and women	1951

At one extreme, all four of these provisions had been ratified by 1994 by Spain, Niger, and Zambia, whereas none had been ratified by the US, Botswana, Mauritius, South Africa, South Korea, Malaysia, Singapore, Thailand, and a few other places.

Although the adoption of an ILO convention likely would not matter much directly for a country's labour market policy, the number of these ratifications may nevertheless proxy for the government's general stance regarding intervention into labour markets. If the number of ratifications (at any date up to 1994) of the four conventions is added to the system in Table 1, then the estimated coefficient of the ILO variable is -0.0059 (s.e.=0.0043) in the growth-rate system and 0.031 (s.e.=0.019) in the investment-ratio system.[10] The point estimates suggest that more regulation lowers growth for given investment but tends to raise investment. Because neither coefficient estimate is statistically significant, the best inference is probably that the ILO number is not a good proxy for the state of labour market regulation. So cross-country estimation of the effects of labour market regulation requires better data on these regulations.

3. Other policy influences on growth and investment. Other researchers have studied additional ways in which government policies affect

[9] For descriptions of the main conventions, see International Labour Organisation (1990). Information on country ratifications is in *International Labour Organisation* (1995).

[10] These systems include the one ILO variable in all three equations and all three instrument lists.

economic growth. Sachs and Warner (1995) focus on international openness, as reflected in tariff and non-tariff barriers, the black-market premium on foreign exchange, and subjective measures of open policies. The overall finding is that increased openness to international trade promotes economic growth. In my research, I found that it is difficult to isolate these effects once the variables described earlier in this paper are held constant. My view is that this difficulty reflects problems in measuring policies that influence international openness, not the lack of importance of this openness.

King and Levine (1993) analysed the development of domestic capital markets. They used various proxies for this development, including the extent of intermediation by commercial banks and other domestic financial institutions. The general finding is that the presence of a more advanced domestic financial sector predicts higher economic growth. The main outstanding issue here is to disentangle the financial-development effect on growth from the reverse channel. In particular, it is important for future research to isolate the effects of government policies—for example, on regulation of domestic capital markets—on the state of financial development and hence on the rate of economic growth.

Easterly and Rebelo (1993) examined aspects of public investment and also considered the nature of tax systems. One result is that public investment does not exhibit high rates of return overall. The main positive effects on economic growth showed up for investments in the transportation area. Regarding tax systems, the findings were largely inconclusive because of the difficulties in measuring marginal tax rates on labour and capital incomes in a consistent, accurate way for a large sample of countries. An important priority for future research is better measurement of the nature of tax systems.

3. Implications of the cross-country findings for the most advanced countries

The cross-country evidence provides good and bad news for the growth prospects of the US and other advanced countries. The good news is that the basic institutions and policies of these successful places are favourable in comparison with those of most other countries. In particular, the legal systems and public bureaucracies function reasonably well, markets and price systems are allowed to oper-

ate to a considerable extent, and high inflation is unusual. The population is also highly educated and rich.

The bad news is that successful countries cannot grow rapidly by filling the vacuum of non-working public institutions or by absorbing the technologies and ideas that were developed elsewhere. Moreover, the levels of physical and human capital are high, and further accumulations are subject to diminishing returns. (Although test scores—and, hence, schooling quality—could no doubt be improved substantially in the US.) These considerations result in the relatively low growth forecasts for the most advanced countries in 1996-2006 that are shown in Tables 2 and 3—1.1% for the US, -0.2% for France and Germany, 0.1% for the UK, 0.7% for Canada, and 0.0% for Sweden. Italy and Switzerland do somewhat better at 1.5% and 1.6%, respectively, and Japan is at 1.8% (well above its recent actual performance).

Sustained growth in the leading countries depends on innovations that lead to new products and better methods of production, the factors stressed in the endogenous-growth theories. This kind of technological progress occurs, and the rate of progress is responsive to policies that shape the economic environment. But the empirical evidence suggests that feasible policies will not improve technology rapidly enough to raise the long-term per capita growth rate above the range of 1- 2% per year. In fact, maintaining this rate of advance will be a challenge in the long run.

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