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Only income diverges: A neoclassical anomaly

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Abstract

The neoclassical growth model (NGM) is only consistent with the absolute divergence in output levels we observe if some determinants of steady state income are also diverging. In this paper we show that accumulation rates of physical and human capital are actually significantly *converging*, as are openness to trade and several variables measuring institutional quality. Output divergence in the face of input, policy and institutional convergence is a deep anomaly for the NGM.

JEL classification: 040; 047
Keywords: Economic growth; Convergence

1. Introduction

At the country level of analysis the world income distribution is characterized by continuing divergence over time (Pritchett, 1997). This in itself is not evidence against the neoclassical growth model (NGM) because said model only predicts that a country will convergence to its own, possibly unique, steady state (Barro and Sala-I-Martin, 2002; Mankiw et al., 1992). However, in order to reconcile output divergence with conditional convergence in the NGM, some determinants of steady state income must also be diverging.

In this paper, using a sample of 90 countries from 1961–1999, we confirm the finding of strong and continued income divergence. However, our main result is to show a strong tendency towards convergence in the investment rates of both human and physical capital, along with two major policy variables often used in augmented growth regressions: government spending and openness to trade. This significant convergence in inputs and policies makes it problematic for the standard neoclassical growth model to explain the observed divergence in per-capita output levels. In other

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words, we find "convergence, big time" in many input and policy variables, which deepens the puzzle of pervasive output divergence.

We go on to divide this data into two groups: 22 rich countries and 68 developing countries. We show that the Solow model is consistent with the data for the 22 rich countries as policies and output both converge in this sub-sample. However, in the 68 developing country sub-sample, inputs and policies are converging while output is rapidly diverging. Thus, while developing countries' inputs and policies are converging to those of the rich countries, their output levels are not, which means that the mimicking of rich countries may be necessary, but definitely is not sufficient, to achieve output convergence.

Finally, we step outside the neoclassical framework to investigate whether cross country patterns of R&D spending, financial development, or institutions are consistent with the observed patterns of output divergence. We find that R&D spending and one measure of financial development evolve in a manner generally consistent with that of national incomes, which cannot be said of capital accumulation, education, degree of openness or size of government. Of course, these variables may be endogenous, that is caused by growth instead of causing growth, but at least we do not rule them out as potentially important correlates worthy of further study.

Section 2 describes our data and contains our basic results on the evolution of the dispersion of inputs and outputs. Section 3 explores whether alternative theories are consistent with the output dispersion data. Section 4 concludes.

2. Data and results

Our main data is from the Penn World Tables Mark VI (Heston et al. (2002)) and includes all the countries with a quality grade of at least a C who have complete data. We use equal weights rather than population weights for our observations. While population weights are relevant for studying welfare, the country level is the appropriate unit of analysis for testing the predictions of the NGM. We only use countries with complete data because countries dropping in and out of the sample could spuriously influence the evolution of the cross country dispersion of the variables under study. Appendix A lists all the variables used in the paper, along with their sample periods, countries used, and data sources.

Our test for divergence is as follows. First, we construct a time series of the annual cross country dispersion for the natural log of the variable under study. Next, we fit a linear trend to the dispersion data. If the trend is positive and significant, we conclude the variable is diverging across countries. If the trend is negative and significant, we conclude the variable is converging across countries.[1] This type of convergence test applied to output cannot tell us anything directly about conditional convergence. However, when we combine it with similar tests applied to the determinants of the steady state, we can make inferences about the empirical validity of the NGM.

2.1. Full sample results

Panel A of Fig. 1 shows our 90 country evidence on global output convergence. As can be seen, there is a significant positive trend in the standard deviation of the log of per-capita income

[1] Note that a variable may have already converged before our sample begins and be constant over time during our sample. Conversely a variable may be very heterogeneous across countries, but the degree of heterogeneity remains constant. Our test would not be able to correctly classify such a variable in either of these cases. In the literature, our convergence concept has been labeled "sigma" convergence as it takes a declining variance over time as evidence in favor of the convergence hypothesis.

in the sample. This positive trend seems to accelerate from 1975 onward. This figure serves to document that divergence does occur in our sample.[2,3]

The above information is not really news, nor is it, in itself, an indictment of the neoclassical growth model. However, what we show next, in combination with Panel A of Fig. 1, presents a real paradox for the NGM with common long run growth rates. Panel A of Figs. 2 and 3 show the dispersion of investment rates, primary school enrollment rates, and secondary school enrollment rates for the full 90 country sample.[4] Again, given that incomes are secularly diverging, the standard neoclassical model requires that at least some determinants of the steady state to also be diverging. Clearly though, they are not. In all three cases we estimate a significantly *negative* time trend.[5] The juxtaposition of these figures is a telling example of the simultaneous input convergence and output divergence that is problematic for the NGM.

While the data in the figures do not uniformly show steady decline, and the goodness of fit for the negative and significant linear trend varies across variables, it is important to note that all we really require for the paradox is the non-divergence of determinants of the steady state. Panel A of Fig. 2 and the entirety of Fig. 3 clearly suffice to rule out the possibility that investment or education rates are diverging over time.[6]

Many studies of growth use a variety of additional factors as variables that can partly determine the steady state level of income. If these factors do exist and they are diverging over time, then the data could be consistent with some form of an augmented neoclassical model. Note, however, that many frequently used measures of cross country differences like being landlocked, having a tropical climate, or a particular colonial history cannot explain continuing divergence as they do not vary over time. Given that output is secularly diverging, the neoclassical model with common long run growth rates requires some determinants of the steady state to also be diverging.

Here we consider government consumption spending and openness to trade as time-varying additional potential determinants of the steady state and evaluate the evolution of their cross country dispersion over our 1961–1999 sample. As seen in Panel A of Figs. 4 and 5, government spending and openness both exhibit non-divergence in the sense that the time series of their standard deviations both contain a negative and significant time trend.[7] We also investigated

[2] Strictly speaking the NGM applies to output per worker, though we are generally more interested in output per-capita for policy purposes. We redid this experiment using output per worker instead of per-capita and report the results in Appendix B. We find exactly the same results: the dispersion of income per worker has significantly risen over the sample period.

[3] The NGM implies that in the steady state countries should be on parallel growth paths and we believe the variance (or standard deviation) is the appropriate measure of dispersion here. However, one can use the coefficient of variation (i.e. the standard deviation divided by the mean) without materially changing our results. For example, Appendix C shows that the coefficient of variation of per-capita income has also significantly risen during the sample.

[4] Note that all variables used in this section are in natural logs. Data on school enrollment are taken from the World Bank's World Development Indicators (2005).

[5] The finding that enrollment rates are converging supports Pritchett (2004), who finds in a large sample of countries that levels of human capital (measured by enrollment rates, literacy levels, or years of education) have converged while income per worker has diverged.

[6] These results imply that growth accounting should find TFP levels diverging over time, which indeed can be plainly seen in the Bosworth and Collins (2003) data. However, diverging TFP is inconsistent with the standard neoclassical growth model based on a common rate of technological progress.

[7] Not all models of trade and growth predict that convergence will follow from liberalization. Bajona and Kehoe (2006) show that the occurrence of convergence will depend on the elasticity of substitution between traded goods. They present examples where factor prices equalize but incomes diverge.

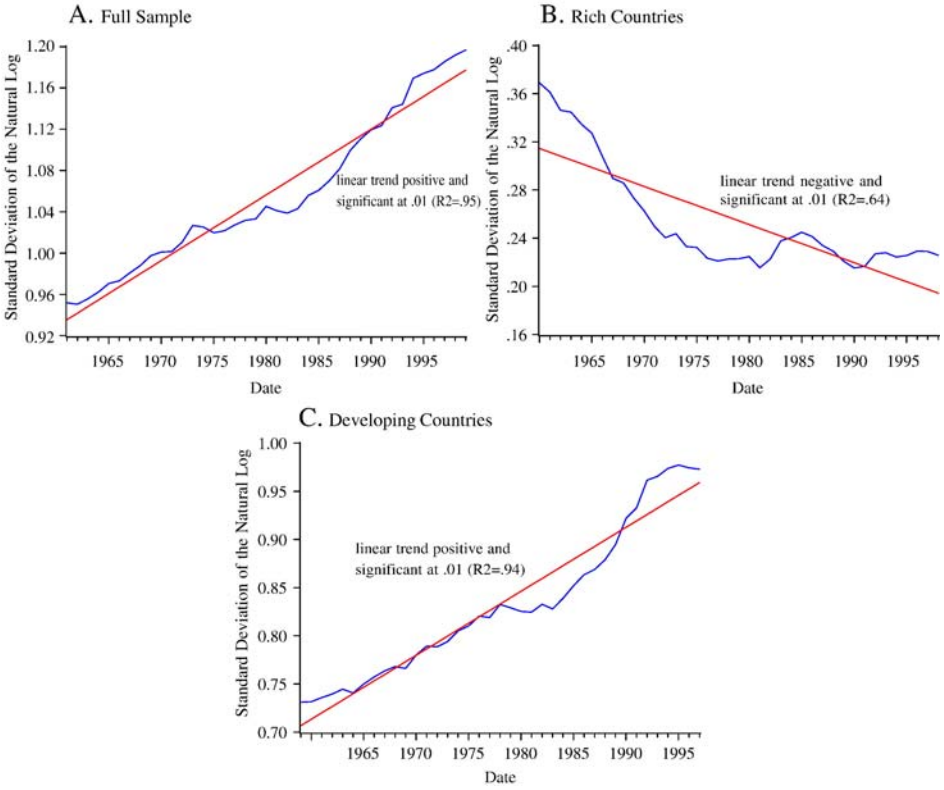

Fig. 1. The dispersion of per-capita income in the full sample and across income groups.

inflation and the black market premium as additional policy variables that may influence steady state income and again found a lack of any evidence that the cross country dispersion of these variables is growing over time.[8]

2.2. Sub-sample results: the rich vs. the developing countries

In this section, we split the sample into two groups; the 22 richest and the 68 developing countries and re-do our analysis of the dispersion of output and of the determinants of the steady state separately for each group. When it comes to output dispersion, the difference between the two groups is striking. As Panels B and C of Fig. 1 show, the rich country income dispersion falls rapidly until 1980 and then remains generally flat after that point with a net decline of about 33%. In contrast, the developing country dispersion rises steadily throughout the sample for a net increase of around

[8] These results are not presented graphically to conserve space, but are available from the authors upon request. The data for inflation and the black market premium are taken from Global Development Network Growth Database at New York University. The inflation data covers 56 developing countries and all 22 rich countries, while the black market premium covers 52 developing countries and 20 rich ones. See Appendix A for more details on the coverage of these two variables.

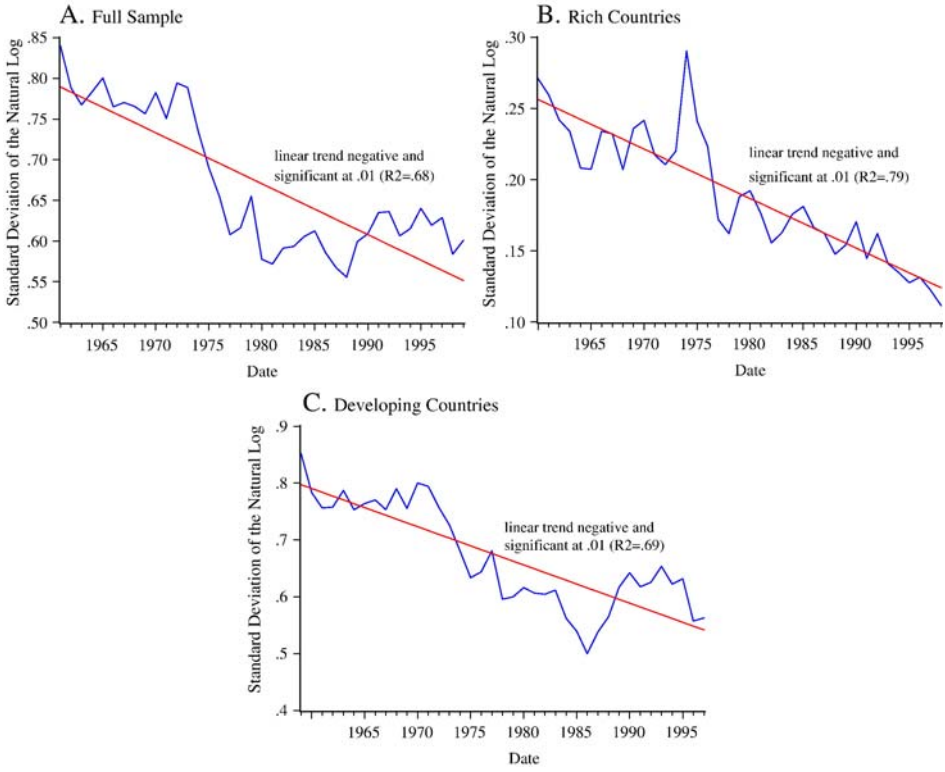

Fig. 2. The dispersion of investment rates in the full sample and across income groups.

25%.[9,10] Obviously, the rich countries' dispersion data exhibit a significant negative trend, while the developing countries' dispersion data exhibit a very strong positive trend.[11]

We now turn to a comparison of the evolution of investment rates in physical and human capital, the key determinants of the steady state in the neoclassical model. These results are shown in Panels B and C of Fig. 2 and in Fig. 6. In both country groupings, the investment and education variables are converging (in the sense that they have a significantly negative time trend), or at least not diverging over time. We do not see the same big difference in the evolution of dispersion of inputs that we saw in the dispersion of output between these two groups.

[9] As per footnote 2, income per worker may be a more appropriate variable for the NGM. We repeat this sub-sample analysis for income per worker and find the same results as those reported in the text for per-capita income. The results are displayed in Appendix B.

[10] As per endnote 3, we redo this experiment using the coefficient of variation (CV) and find the same results. The CV of income is significantly falling in the rich country sample and significantly rising in the developing country sample. These results are presented in Appendix C.

[11] We have followed common practice here and identified the rich countries as the currently rich countries. This creates selection bias in favor of finding convergence, as DeLong (1988) argued. If we choose instead the 22 richest countries in 1960 as our rich group, then both the rich and developing sub-samples significantly diverge over the sample. These results are presented in Appendix D. We thank an anonymous referee for reminding us of this point. Thus, the convergence in inputs and policies along with output in our ex post rich country sub-sample is not unambiguous evidence in favor of the NGM or of any notion of club convergence. We use this split as it is one that many researchers are familiar with and the clashing pattern of convergence between the two groups facilitates searching for relevant explanatory variables in later sections of the paper.

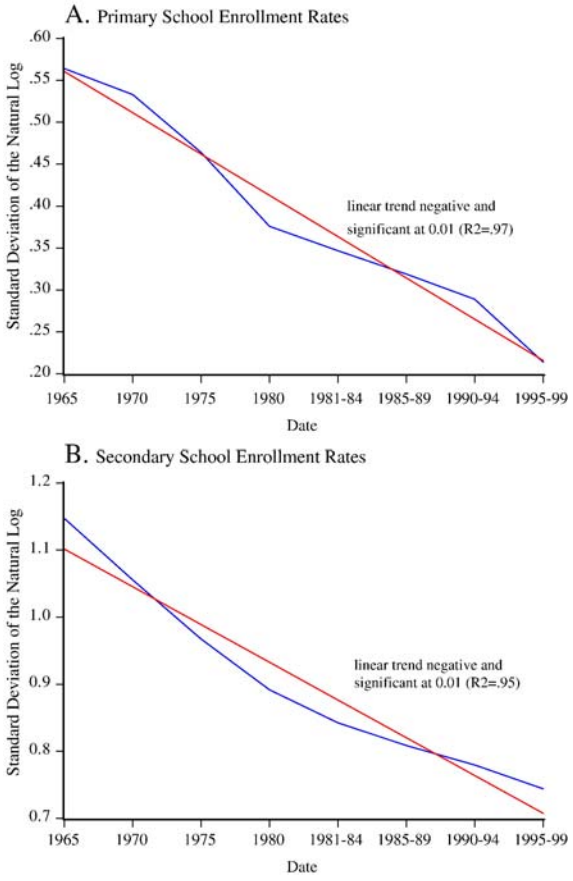

Fig. 3. The dispersion of primary and secondary school enrollment rates across 90 countries.

Finally, Panels B and C of Figs. 4 and 5 examine the behavior of government spending and openness across the two country groupings. Again, both sub-samples show significant convergence behavior. When we again consider inflation and the black market premium we find no evidence of divergence over time for either series in either country grouping. The 22 rich countries evolve in a manner consistent with the neoclassical model, but the 68 developing countries present striking evidence against the model.

2.3. What about papers finding conditional convergence?

We have shown that investment rates and economic policies are converging around the world at the same time that output is diverging. Thus, we find no evidence of conditional convergence (assuming a common growth rate of technology) in either our full sample of countries or the 68 developing country sub-sample.[12] Yet, there is a literature claiming evidence in favor of

[12] While our results are novel, we are not the only ones questioning the utility of the neoclassical model. Hausmann et al. (2005) argue that the standard growth variables used in the literature are not very helpful in explaining growth accelerations, while Pritchett (2003) argues for a portfolio of models that apply to different stages of the development process.

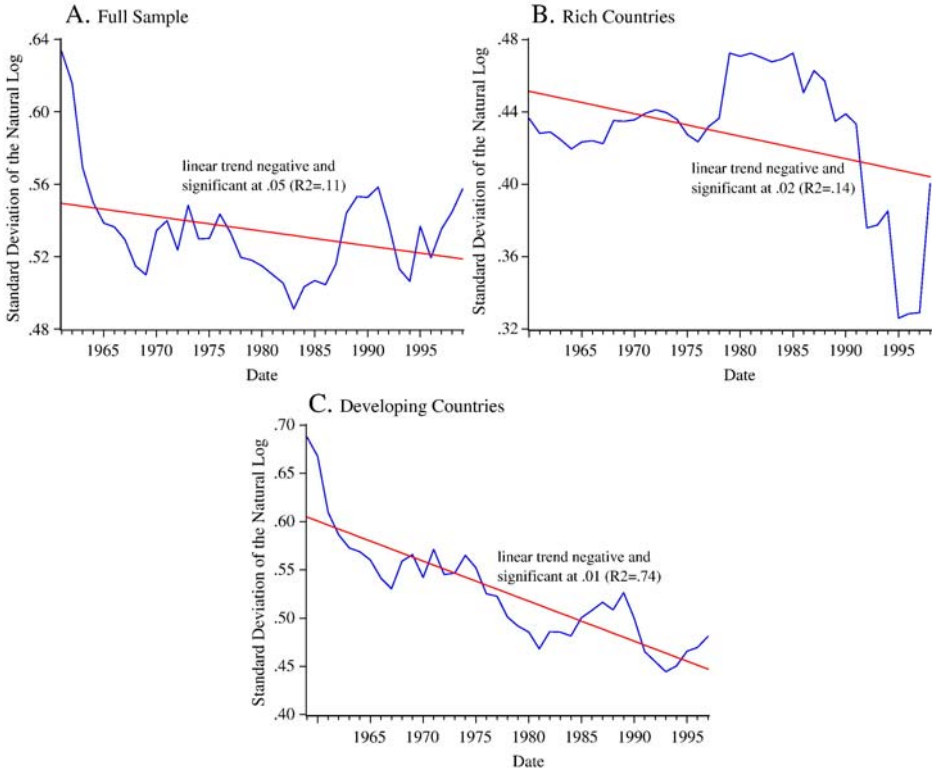

Fig. 4. The dispersion of government spending in the full sample and across income groups.

conditional convergence. Well known papers include Mankiw et al. (1992), Sala-i-Martin (1996), Islam (1995), and Caselli et al. (hereafter CEL, 1996).

While a full blown discussion of the relative merits of our approach compared to the traditional approach is beyond the scope of this present paper, we can note that (1) a lot of the pro-conditional convergence regression evidence is cross-sectional and the cross-sectional growth regression approach has been cogently criticized by Friedman (1992), Quah (1996) and Durlauf (2003), among others; (2) In a panel context, Islam rejects the augmented NGM (by finding a negative and significant coefficient for education), as do CEL. However, they go on to interpret the coefficients of the model with respect to the NGM. In our view, once the underlying theoretical model is rejected, it is difficult to interpret estimated coefficients strictly as the rejected model would prescribe.[13] That is to say, variables they interpret as having level effects may in fact be having growth effects; (3) The regression models all impose parameter homogeneity on the data

[13] Durlauf (2003, p.10–11) makes this point very well: "Can the presence of such factors as being interpreted as consistent with convergence? Users of cross-country growth regressions who wish to interpret them as describing neoclassical growth dynamics typically argue that (they) capture level differences in production functions across economies. However, this is merely an assertion; the presence of such factors can just as easily be interpreted as occurring due to differences in long run growth rates. Similarly, it is an assertion to suggest that these variables are simply proxies that facilitate the correct measurement of technology and preferences, unless one stretches the meaning of technology and preferences beyond what economists generally mean by them." In other words, if we lose the theoretical anchor of the Solow model, the interpretation of policy variables in the growth equation becomes problematic.

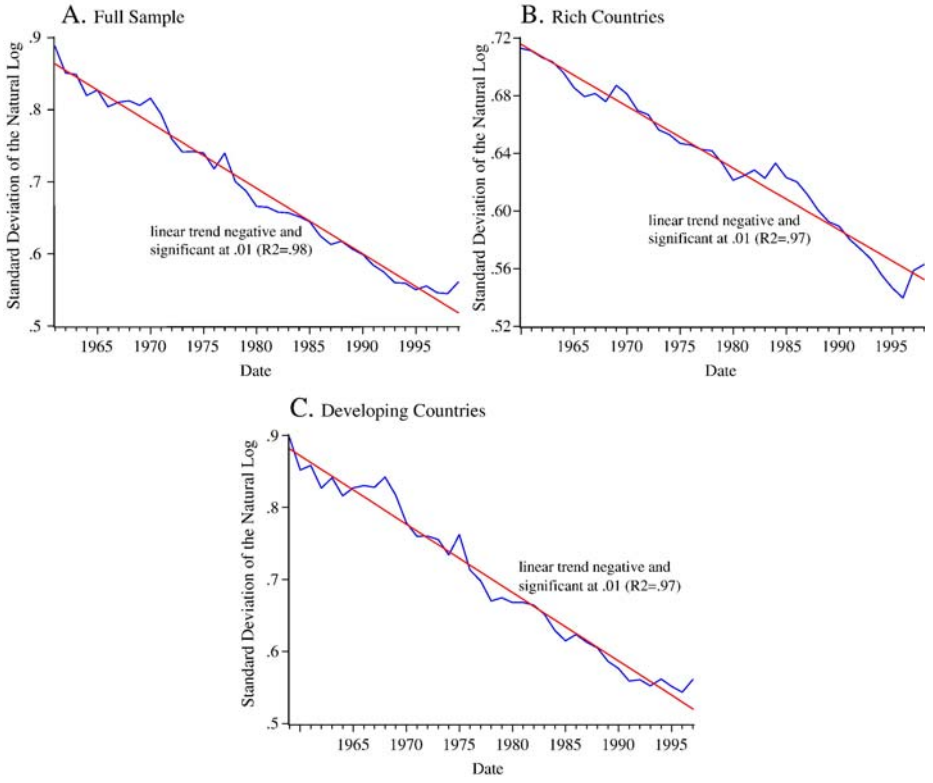

Fig. 5. The dispersion of openness in the full sample and across income groups.

in a way that our graphical approach does not. Grier and Tullock (1989) test for and reject such homogeneity in the Penn World Tables data; and (4) Lee, Pesaran, and Smith (1997) argue that the data support the idea of idiosyncratic long run growth rates.

3. Thinking outside the (neoclassical) box

To summarize our results to this point, we can say that for our 90 country sample in general and the 68 developing country sub-sample in particular, we see no evidence of either absolute or conditional convergence. In both these samples, output is diverging while the neoclassical determinants of the steady state (and some important policy variables) are converging. In this section, we attempt to turn the analysis from the negative toward the positive by investigating other models or variables that may be consistent with the finding that the rich countries are converging while the others are diverging.

3.1. R&D and technology diffusion

The first case under consideration is that of technological diffusion, where at least part of the diffusion depends on a country's own research and development efforts. Specific relevant papers include Parente and Prescott (1994), Eaton and Kortum (1996), Howitt (2000) and Klenow and Rodríguez-Clare (2005). In these models, with other relevant factors held constant, incomes

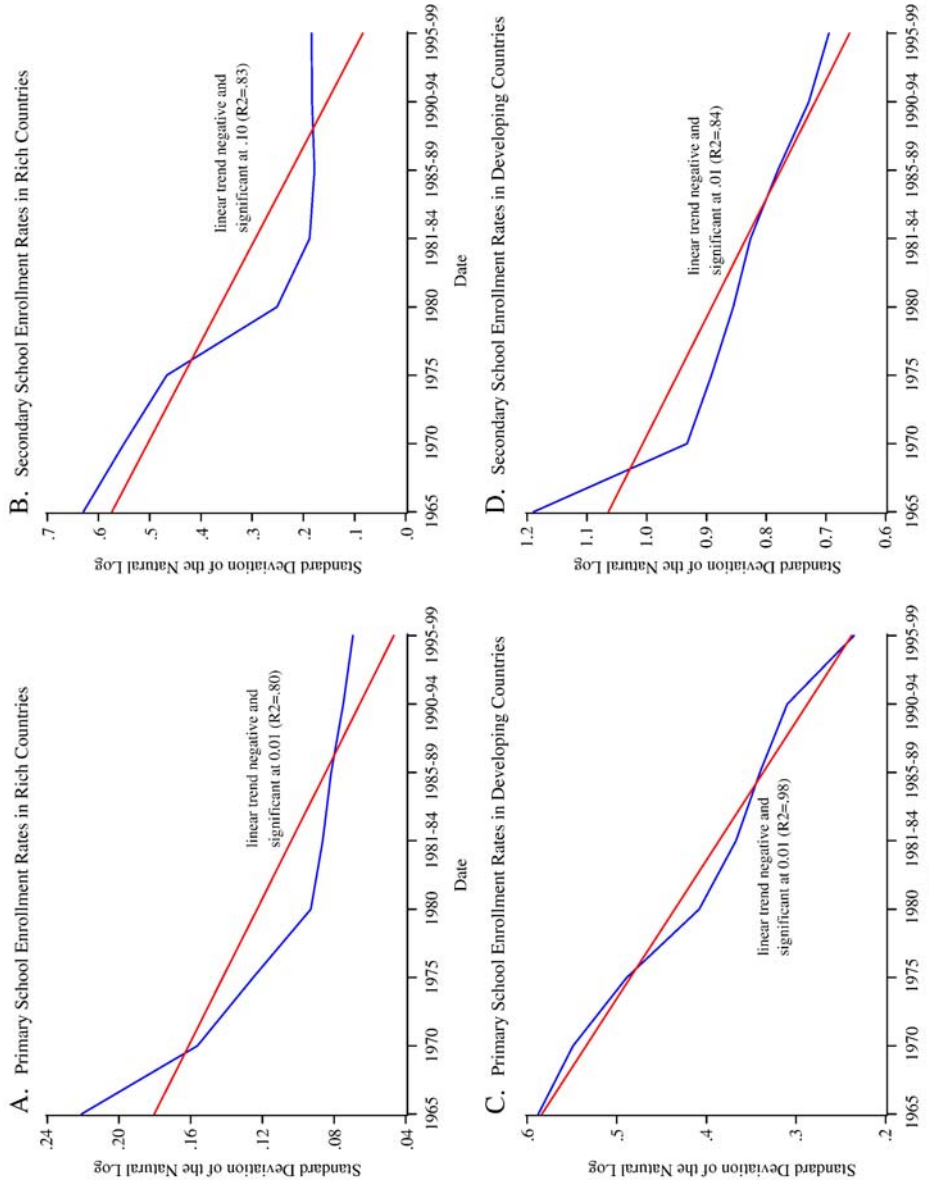

Fig. 6. The dispersion of primary and secondary enrollment rates across income groups.

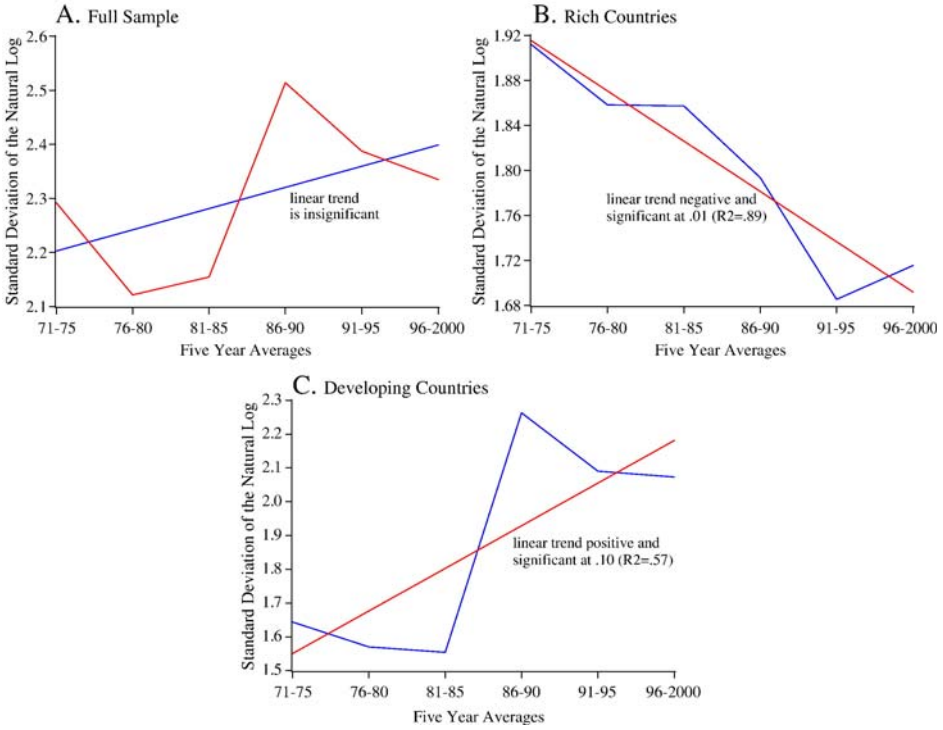

Fig. 7. The dispersion of expenditures on R&D in the full sample and across income groups.

would converge (diverge) as R&D rates converged (diverged). To investigate, we use data on national R&D expenditures measured in constant US dollars from Lederman and Saenz (2003). We are able to compile data for 42 countries from 1971–2000. Because many countries do not have complete annual time series, we created 5 year average observations, giving a total of 6 observations per group. The sample includes 21 of the 22 rich countries we have been studying but only 21 of the developing countries.

As before, we examine the evolution over time of the standard deviation of the natural log of R&D across these countries. The results are shown in Fig. 7. We see no significant pattern across the whole sample, coupled with significant convergence among the rich country group and marginally significant divergence across the developing country sample. Given the already observed patterns in the dispersion of output, this R&D pattern is basically consistent with the general implications of technology diffusion via national R&D models. Rich countries show both R&D and income convergence, while developing countries show the opposite. Of course, this last result should be taken with caution as we have R&D data on only a few developing countries.[14]

We also have data on patents granted by the US patent office by national origin of the lead inventor. This data does not fit the theoretical models as well as does R&D spending, but we are

[14] When we consider R&D as a percentage of national income, we see the same pattern. The only difference is that the divergence in the developing sample (as measured by the linear trend) is not significant. These results are available upon request.

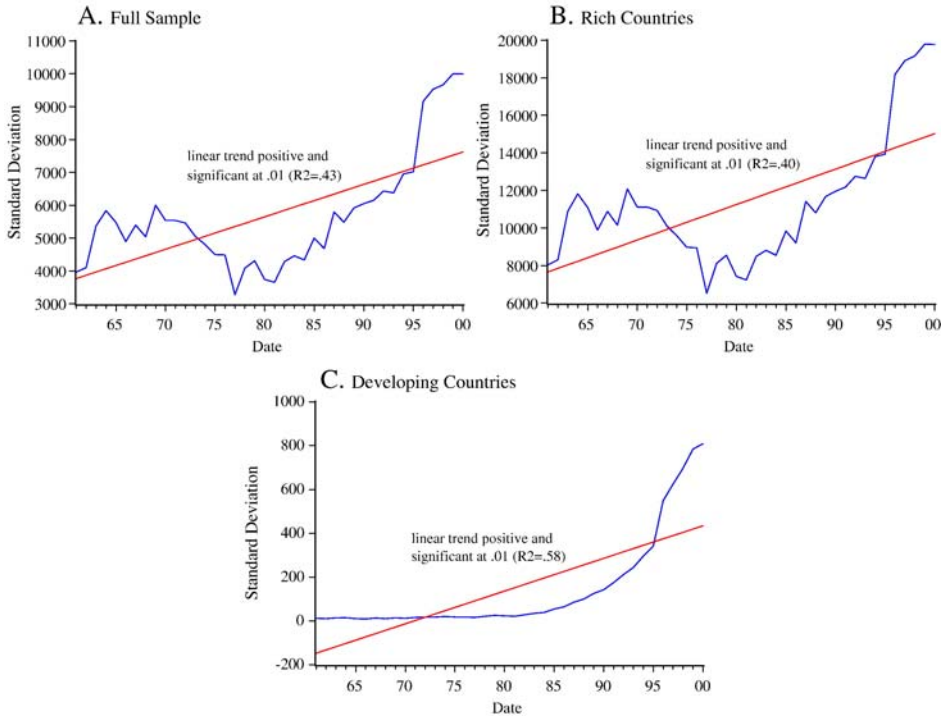

Fig. 8. The dispersion of the number of patents obtained in the full sample and across income groups.

able to get a much bigger data set and Lederman and Saenz (2003) show that the two variables are fairly strongly correlated. Fig. 8 displays our results for the 88 country (21 rich and 67 developing) data set we compiled from Lederman and Saenz. Interestingly we find significant divergence in the full, rich and developing samples, with the developing country sample really only showing increased dispersion from the late 1980s onward. Taken as a whole, the results here indicate that innovation may well play a significant role in explaining income divergence, though clearly further work is needed to flesh out any such claims.

3.2. Financial development

The second case we consider is the currently popular view that financial development is a key to economic growth. Some important papers that espouse this view include Aghion et al. (2005), Levine (1997, 2005), and Levine et al. (2000). In order to investigate whether patterns of financial development are consistent with the patterns of convergence and divergence we see in incomes, we use the data set created by Beck et al. (1999). We compile yearly data on private credit by deposit money banks and other financial institutions to GDP from 1965–2002 for 56 countries, including 21 of our 22 rich countries. We also collect yearly data from 1980–2003 on stock market capitalization as a percentage of GDP for 33 countries, including 17 of the countries in our rich country sample.

Figs. 9 and 10 present the temporal variation in the cross country standard deviations of these variables. Given our knowledge of the evolution of incomes, private credit displays the

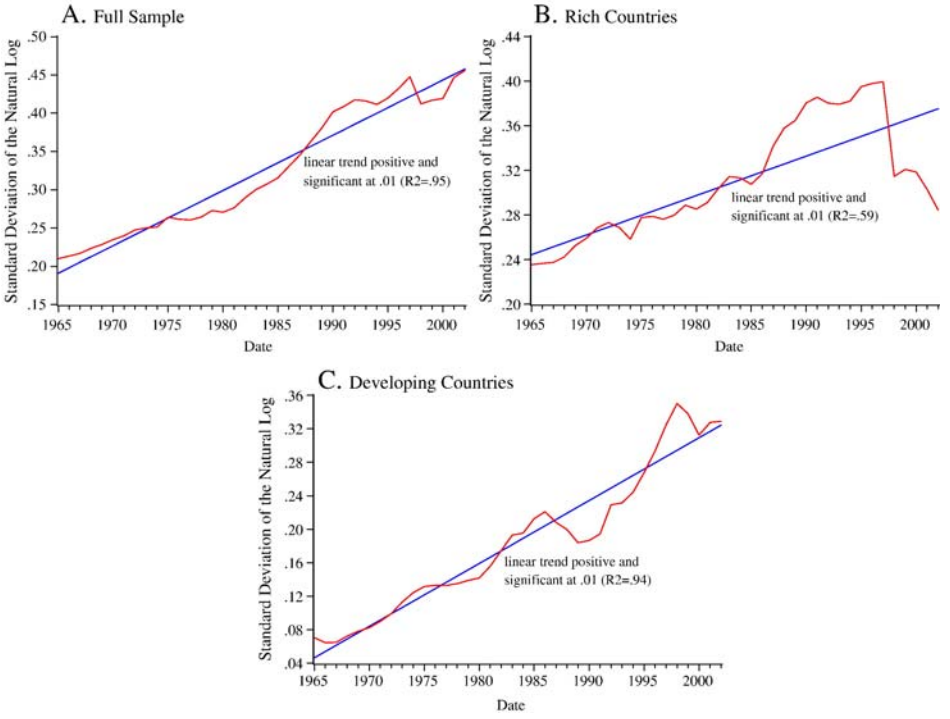

Fig. 9. The dispersion of private credit by deposit money banks and other financial institutions to GDP, in the full sample and across income groups.

pattern one would expect if financial development were an important growth factor for developing countries. However, private credit shows significant divergence in the rich country sample, while the data on stock market capitalization show convergence in all three groups of countries.

Another aspect of financial development that has received attention in the literature is how open a country is to international capital flows (see Edison, Klein, Ricci, and Slok (2004) for a survey). Several authors have produced indices of capital openness, with Chinn and Ito (2006) a recent example. Here we take the Chinn–Ito index, which is formed by taking the first principal component of a set of dummy variables representing the presence of multiple exchange rates, the existence of restrictions of current account transactions, the existence of restrictions on capital account transactions and the existence of a requirement that export proceeds be surrendered to the government. We have annual data from 1970 through 2004 for 80 of our 90 countries (19 rich and 61 developing). The dispersion of the Chinn–Ito index of capital openness is presented in Fig. 11. Again we see a pattern that is consistent with the dispersion of incomes in that in the full sample capital openness is diverging, while in the rich sub-sample it is converging.

Of the three measure of financial matters we investigate, the index of capital openness is the only one to evolve in a manner fully consistent with the evolution of incomes, making it worthy of further study.

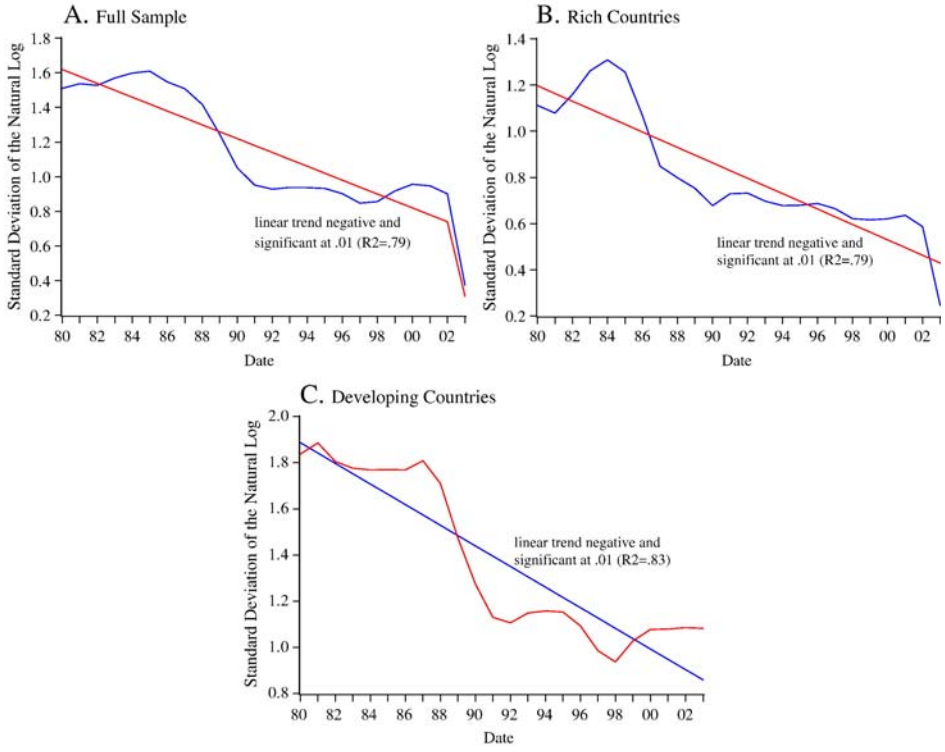

Fig. 10. The dispersion of stock market capitalization to GDP, in the full sample and across income group.

3.3. Institutional quality

It is often asserted that institutions are the key to economic growth. However, all the models of institutions and growth of which we are aware (see, for example, Acemoglu et al., 2001; Rodrik et al., 2004) actually allow institutional variables to effect steady state income *levels* and not long run *growth rates*. Thus to explain the patterns of output divergence we see in the world, we would need to find corresponding patterns of institutional divergence. However, many variables used to represent institutions, such as colonial heritage, and legal origins, are time invariant, and thus disqualified as explanations.

One popular time-varying institutional quality variable is the constraints on the executive variable from the Polity IV database (Marshall and Jaggers, 2002). This variable is defined as "the extent of institutionalized constraints on the decision-making powers of chief executives, whether individuals or collectivities" and ranges from 0 to 7, with a 0 representing unconstrained chief executive. Glaeser et al. (2004, p. 4) argue that this variable is "the best of the measures most commonly used in the literature."

We present our now familiar analysis for this variable in Fig. 12. As can be seen, this variable shows significant convergence in the full sample and both sub-samples, meaning that it does not evolve in a manner consistent with the output divergence we see in the full sample and the developing country sub-sample. We also use the International Country Risk Guide (ICRG) database, which gives us data on bureaucratic quality, corruption, and overall law and order for a large number of countries from 1985–2000. In each case we found the cross

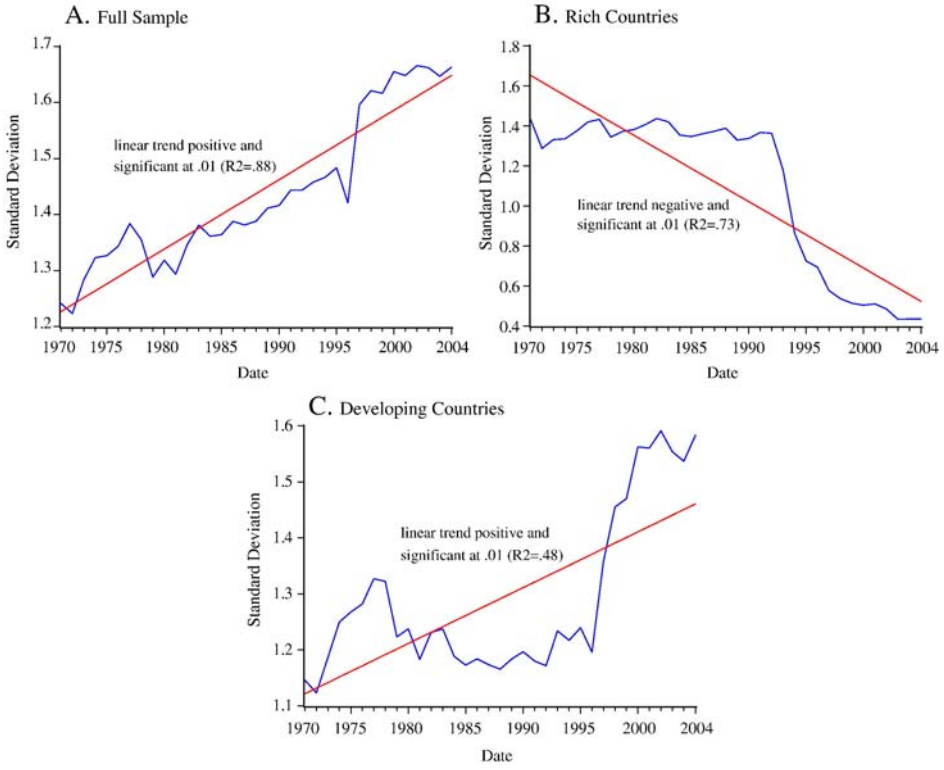

Fig. 11. The dispersion of the openness to capital, in the full sample and across income group.

country dispersion to be significantly falling over time for both country groupings, providing further evidence that institutional quality divergence does not appear to be driving output divergence.[15]

4. Discussion

We have shown that the world income distribution is diverging, but the fundamental variables that determine that distribution according to bedrock theory are converging (or at the very least, not diverging). In plain English, outside of the 22 richest countries, the neoclassical model, augmented or vanilla, gets almost nothing right about growth. The failure of this model is more than just academic, given the prodigious amount of policy advice dispensed to poor countries based upon it. We have seen that while the developing countries have shown considerable initiative and success in duplicating rich country outcomes in terms of investment, education, openness, and institutional quality, many have not received the expected payoff.

The obvious question is: where do we go from here? While this paper is mainly concerned with convincing the reader that recent output divergence has occurred at the same time as significant convergence in the main determinants of steady state income in the neoclassical growth model, we conclude with some observations about possible reasons.

[15] The results are not shown to conserve space but are available upon request.

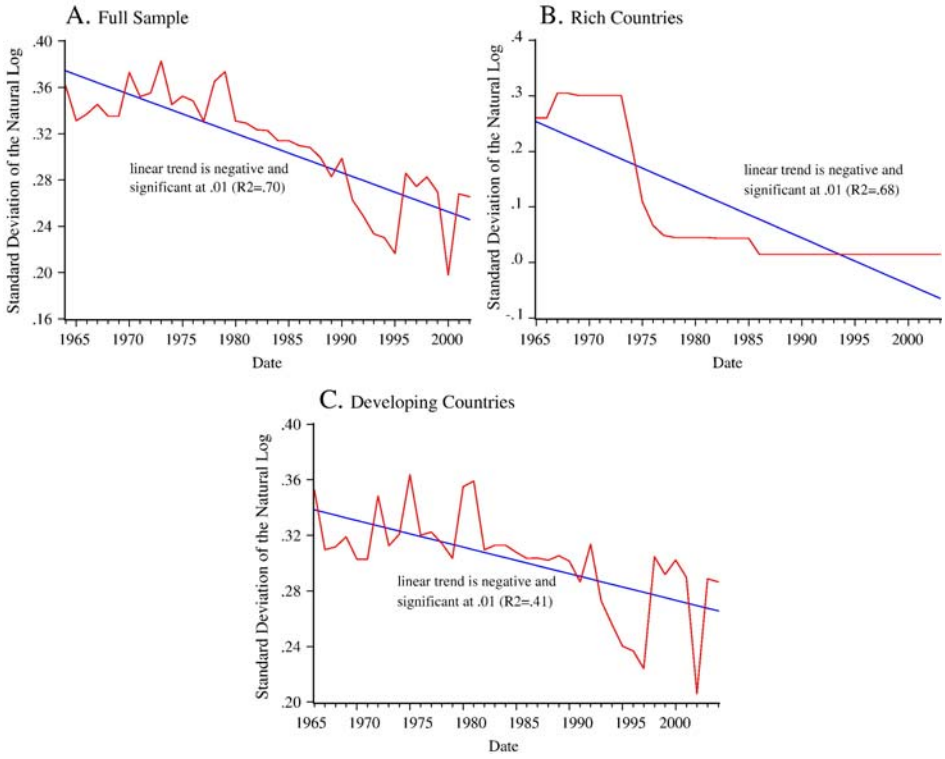

Fig. 12. The dispersion of political constraints on the chief executive, in the full sample and across income group.

First, our limited evidence on the evolution of R&D spending and openness to capital flows is consistent with these variables having a role in determining steady state incomes and possibly helping to explain the patterns of income divergence we observe. Further work, both theoretical and empirical, on these factors seems well warranted.

Second, it may be that there are sequencing effects, interaction effects, or long time delays in how policy/input convergence affects income levels. That is, it may take decades for increased education to affect steady state income, or the effect of openness on income may depend in some way on the existing level of R&D, education, or financial development. Another possibility is that a certain level of shared institutional quality or homogeneity is a necessary precondition for policy convergence to produce income convergence.[16,17]

Third, it may be the case that the existence of scale effects should be reconsidered.[18] While Jones (1995, 2005) shows that traditional scale effects associated with R&D effort or population are generally inconsistent with the data, we have in mind an idea of effective scale. That is to say, a large country with trade and financial barriers and insecure property rights may actually be smaller in terms of a growth-effective scale than a small, but open country with strong contract enforcement. We plan to investigate this idea in future work.

[16] See Pritchett (2006) for some examples of how un-modeled interaction effects can bias traditional growth equations. Ben-David (1993) argues that "deep integration" is necessary for trade openness to produce income convergence.

[17] Several recent papers argue that once we control for institutions, the effect of policies on growth disappears. See, for example, Easterly and Levine (2003), Acemoglu et al. (2001) and Rodrik et al. (2004).

[18] Hall (1990) also argues that increasing returns are important for explaining the behavior of the Solow residual in the USA.

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Appendix A. Variables and samples

A.1. Initial sample

The data for per-capita income (and per-worker income), government spending, investment, and openness to trade all come from the Penn World Tables 6.1. The education variables were constructed with data from the World Development Indicators. This initial sample covers 90 countries from 1961–1999. The 22 rich countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United States, and the United Kingdom.

The 68 developing countries are: Argentina, Bangladesh, Barbados, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Chile, China, Colombia, Congo, Rep., Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, the Gambia, Ghana, Guatemala, Guinea, Honduras, Hong Kong, Hungary, India, Indonesia, Iran, Israel, Jamaica, Jordan, Kenya, Korea, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Morocco, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka, Syria, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela, Zambia, and Zimbabwe.

A.2. Research and development

This variable was constructed with data from Lederman and Saenz (2003). It covers 42 countries (21 rich countries and 21 developing ones) from 1971 to 2000. Rich country data was not available for Iceland and Luxembourg (although we included data for Germany, which was not available for our initial variables). The 21 developing countries are: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Egypt, El Salvador, Hungary, India, Indonesia, Israel, Korea, Madagascar, Mexico, Peru, Singapore, Taiwan, Thailand, Turkey, and Venezuela.

A.3. Patents

This variable was constructed with data from Lederman and Saenz (2003). It covers 88 countries (21 rich countries and 67 developing ones) from 1963 to 2002. Rich country data was not available for Iceland and Luxembourg (although we included data for Germany, which was not available for our initial variables). Complete data was also not available for Barbados, Gabon, and the Gambia (although we included data for Hungary and Taiwan, neither of which was available for our initial variables).

A.4. Stock market capitalization

This variable comes from Beck et al. (1999) and covers 32 countries (17 rich countries and 16 developing ones) from 1980 to 2003. Rich country data was not available for Finland, Iceland, Ireland, Luxembourg, New Zealand, and Norway (although we included data for Germany, which was not available for our initial variables). The 16 developing countries are: Argentina, Chile, Colombia, Hong Kong, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Nigeria, Philippines, South Africa, Thailand, Turkey, and Venezuela.

A.5. Private credit

This variable comes from Beck et al. (1999) and is available from 1965 to 2002 for 56 of the countries from our initial sample (21 rich countries and 35 developing ones). The only rich country data not available were for Luxembourg and Spain (although we included data for Germany, which was not available for our initial variables). The developing country sample includes the following countries: Argentina, Bolivia, Burkina Faso, Chile, Costa Rica, Cote d'Ivoire, Dom. Rep., Ecuador, Egypt, El Salvador, Guatemala, Honduras, India, Israel, Jamaica, Kenya, Madagascar, Malaysia, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Sierra Leone, Singapore, Sri Lanka, Syria, Thailand, Trinidad and Tobago, Uruguay, and Venezuela.

A.6. Openness to capital

This variable comes from Chinn and Ito (2006) and is available from 1970 to 2000 for 80 of the countries in our initial sample (19 rich countries and 61 developing ones). The only rich country data not available were for the Netherlands, New Zealand, and Luxembourg. The developing country sample does not include the following countries: Bangladesh, Barbados, Botswana, China, Costa Rica, Mauritania, and Zimbabwe.

A.7. Black market premium and inflation rates

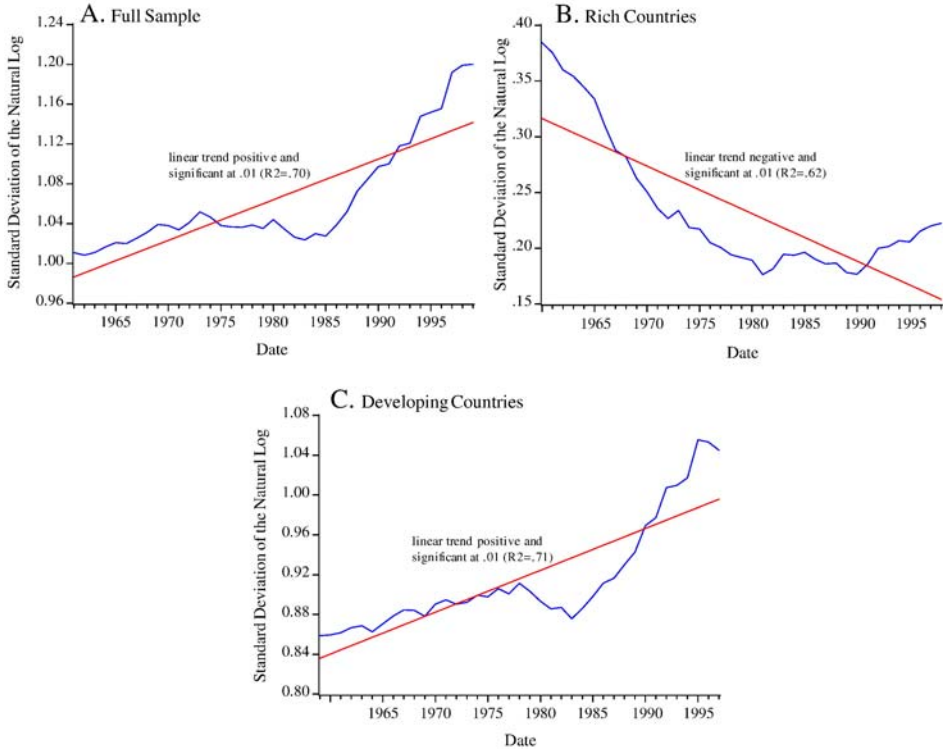
Data on the black market premium and inflation were taken from the Global Development Network Growth Database at New York University. The data were available from 1960 to 1999 for 72 of our countries (20 rich countries and 52 developing ones), while inflation rates are available from 1975 to 2000 for 78 countries (22 rich and 56 developing). Neither variable has data on the Congo, Rep., Guinea, Mali, or Mauritania. The black market premium data is not available for Iceland, Luxembourg, Barbados, Burkina Faso, Cameroon, Cote d'Ivoire, Gabon, the Gambia, Mali, Mauritania, Mauritius, Panama, Senegal, Sierra Leone, Singapore, and Trinidad and Tobago. Full inflation rate data is also missing for Bangladesh, Benin, Brazil, China, Hong Kong, Malawi, Mali, Mauritania, Tunisia, and Zambia.

A.8. Institutions sample

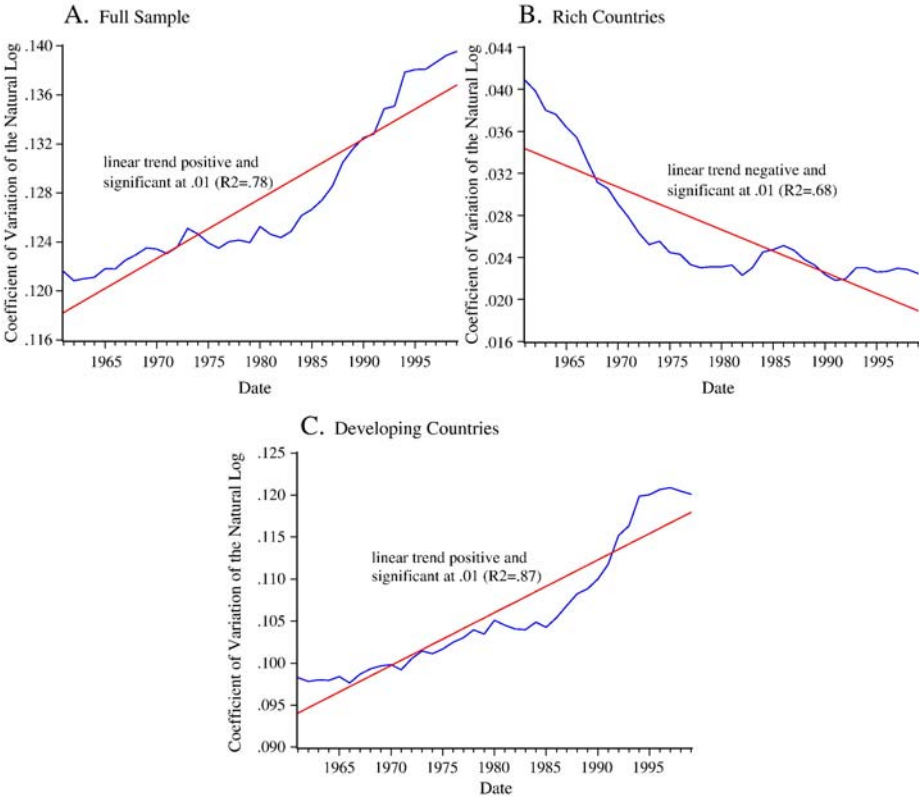
Data on executive constraints came from the Polity IV database, while the data on corruption, bureaucratic quality, and law and order were all taken from the ICRG database. The executive constraint variable was available from 1965 to 2003 for 84 of the countries in our sample (21 rich and 63 developing), while the data on bureaucratic quality, corruption, and

law and order are all available from 1985 to 2000 for 83 countries (22 rich and 61 developing). All four variables are missing full data for Barbados, Burundi, and Mauritius. The executive constraints variable is also missing data on Iceland, Luxembourg, Bangladesh, and Hong Kong, while the other three are missing data for Benin, the Gambia, Mauritania, Nepal, Rwanda (although we included data for Hungary, which was not available for our initial variables).

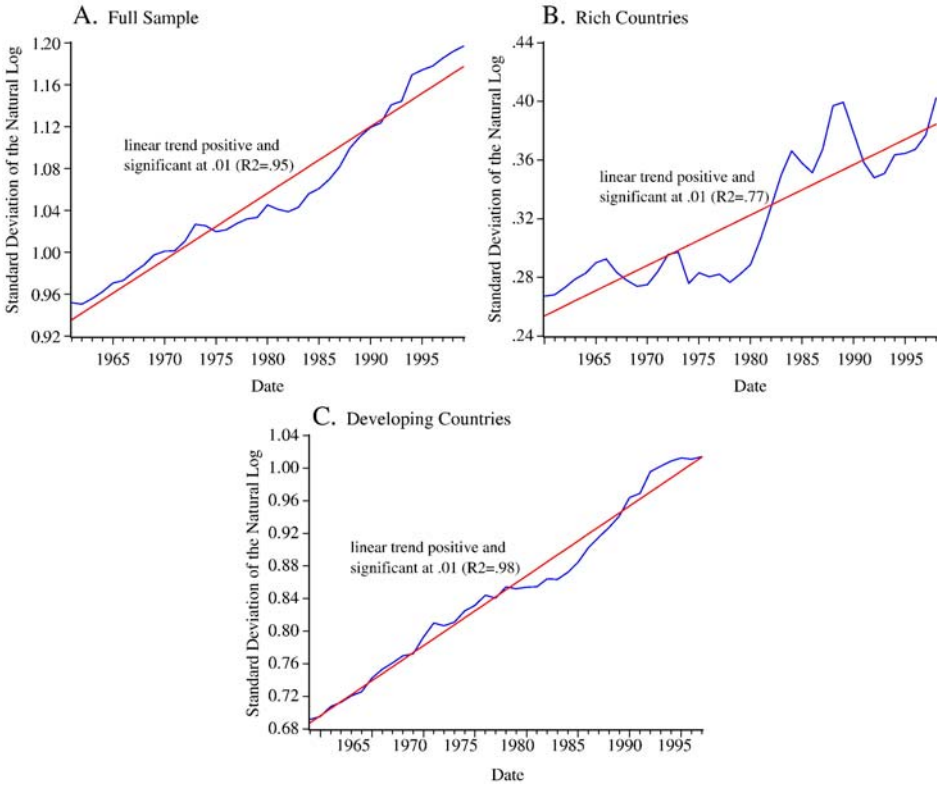
Appendix B. The dispersion of per-worker income in the full sample and across income groups



Appendix C. The dispersion of per-capita income, in the full sample and across income groups using the coefficient of variation



Appendix D. The dispersion of per-worker income, in the full sample and across income groups, using an *ex-ante* definition of rich countries



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