Losing Ground: Latin American Growth from 1955-1999

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Abstract

I evaluate Latin America's relative economic performance by combining the Solow growth coefficients from 22 rich countries and the actual factor accumulation in the region. I find that actual income growth was consistently below simulated growth for all of the countries in the sample, indicating that low productivity is likely behind slow GDP growth in the region. The low productivity growth is partially explained by government consumption spending, ethnic diversity, autocracy, export composition, and educational quality.

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1. Introduction

Several recent papers document the fact that per-capita GDP income is not growing very fast in Latin America, even after more than a decade of structural reform.[1] Unfortunately for the region, this lack of convergence is not just a recent phenomenon; relative per-capita income in Latin America went from 43% of the rich country average in 1955 to only 24% in 2000.[2] Not only is the region as a whole falling behind, but the fall in relative per-capita income is not being driven by any particular outlier country.

In this paper, I investigate the reasons behind the divergence of average incomes in Latin America and the rich, industrialized countries within the framework of the neoclassical growth model. I first determine whether factor accumulation was high enough in the Latin American countries to have theoretically brought about consistently high GDP growth. Specifically, I estimate an augmented Solow growth model for 22 rich countries for the years 1955-1999. I then combine the coefficients from that estimation with actual factor accumulation in Latin America to forecast how fast a representative rich country would have grown with the same level of accumulation as the Latin American country.[3] If simulated income growth is high (and, in addition, consistently higher than actual growth), then other factors besides factor accumulation are probably a major reason behind a country's low growth.

I find that actual per-capita income growth is consistently well below simulated growth for all of the countries in the sample. Even countries that had long periods of sustained income growth still grew slow relative to their potential.[4] For instance, average annual per-capita income growth in Mexico and Brazil from 1960 to 1979 was 1.97% and 2.85%, respectively. While these rates indicate sustained income growth for two decades, they are still significantly below the model's simulated ones (3.91% for Mexico and 5.33% for Brazil). Their economic growth was relatively high, but given their factor accumulation, these two countries were actually under performing. I go on to investigate possible causes for the gap between actual and forecasted growth. Specifically, I find that low levels of ethno-linguistic diversity, high import growth, low government consumption spending, and autocracy are all negative and significantly related to the simulation error. Countries which have tropical climates or are landlocked have higher average simulation error. In addition, I find that the composition of exports matters. The richer countries in the sample that had high manufacturing shares of exports also had lower average simulation errors. Educational quality also helped to explain differences across forecast errors. Countries with lower secondary school class sizes (relative to the rich country average) also had lower simulation errors.

In Section 2, I describe the methodology of the paper in more detail. Section 3 estimates an augmented Solow model of growth for the rich countries and uses the coefficients of that model to simulate growth in Latin America. Section 4 investigates specific reasons for why Latin American countries are actual growth was consistently less than simulated growth, while Section 5 tests whether these factors help to explain the missing growth gap. Section 6 concludes.

2. Methodology

Grier (2003), in a departure from the traditional method of calculating productivity via growth accounting, estimates a version of the augmented Solow model for 21 industrialized countries for the 1960-1990 period and uses those coefficients (combined with actual factor accumulation in East Asia) to simulate per-capita income growth in East Asia during that time.

As she points out, industrialized countries are good benchmarks for estimating an augmented Solow model because they are the most likely to be close to their steady state levels. While no one debates whether Latin American growth is 'miraculous' or not, I employ the same method to determine whether Latin American countries are significant under achievers.

Mankiw, Romer and Weil (1992) derive the following cross-country growth regression, where s_k and s_h represent the income shares invested in physical and human capital, d is the depreciation rate, n is the population growth rate, and g is the growth of labor-augmenting technology. λ represents the speed at which a country's output converges to its steady-state level.

$$\ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = (1-e^{-\lambda t})\ \alpha/(1-\alpha-\beta)\ln(s_k) + (1-e^{-\lambda t})\ \beta/(1-\alpha-\beta)\ln(s_h) - \tag{1}$$

$$(1-e^{-\lambda t})\ (\alpha+\beta)/(1-\alpha-\beta)\ln(n+g+d) - (1-e^{-\lambda t})\ln(Y_{i,t-\tau})$$

While the sum of technology growth and depreciation ($g + d$) is typically assumed to be constant in panel estimations, Maddison (1987) argues that the rate of technological growth in the OECD was significantly higher in the pre-1973 era, meaning the assumption of a constant rate of technological growth would be inappropriate. I assume that $g + d$ sum to .05, but include time dummies in the estimation, which should help to account for any unmodelled changes in the rate of technology growth. I also divide the sample into two sub-samples (1955-1974 and 1975-1999) and find that I cannot reject the null hypothesis of parameter stability at the .10 level.

Another potential problem in estimating the above regression is the possibility that investment is not exogenous. In the empirical growth literature, there has been more and more recognition that investment is likely to be an endogenous variable in growth regressions.[5] For that reason, I use a GMM estimator with a heteroskedasticity and autocorrelation consistent weighting matrix and one lag of investment to identify the equation. In the next section, I discuss the data and also the results of combining rich country coefficients with Latin American inputs to forecast growth in the region.

3. Results

Estimating a Baseline Model with Rich Country Data

In this section, I estimate equation (1) for a panel of 22 rich countries from 1955-1999. The data are averaged into five year intervals, capturing information from average cross country differences and temporal fluctuations over the sample period.[6] All economic data are from the Penn World Tables 6.1.[7] The education variable is the average years of secondary schooling in the population older than 25 years of age divided by the total possible numbers of years of secondary schooling.[8] The data for the numerator comes from Barro and Lee's (2001) updated education data, while the data on total years of schooling across countries comes from UNESCO's Statistical Yearbook on Education.

I treat investment as an endogenous regressor in the model, by using a GMM estimator with a heteroskedasticity and autocorrelation consistent weighting matrix and one lag of investment to identify the equation.[9] I weight the autocovariances with a Bartlett kernel and use Newey and West's (1987) formula to determine the optimum fixed bandwidth (which turns out to be 4). I find that the augmented Solow model explains over half of the variation of growth rates in the sample, with an R^2 of .56. The coefficient on lagged per-capita income is negative and significant at the .01 level, supporting the common finding of convergence in industrialized samples. Investment and secondary education are positive and significantly correlated with per-capita income growth at the .05 and .01 level, respectively. The coefficient on *(n+g+d)*, however, is insignificantly different from zero. From equation (1) above, we know that the coefficients of investment, human capital, and *(n + g + d)* should add up to zero. I perform a Wald test of the null hypothesis that these coefficients add up to zero, and find that I cannot reject the null standard significance levels. Given this, and the fact that the coefficient on *(n+g+d)* is very imprecisely estimated, I re-estimate the equation imposing the Solow restriction that the three coefficients to sum to zero. The coefficient on investment, education, and *(n+g+d)* are now .0138, .00569, and .0195, respectively. I will use these coefficients to simulate Latin American growth in the next section.

Simulated Latin American Growth

I combine the coefficients from the rich country model with actual factor accumulation in Latin America to calculate how fast a representative rich country would have grown during the 1955-1999 time period with the same levels of accumulation. Following Grier (2003), I look at the size and composition of the simulation errors to determine if countries are systematically over or under achieving. First, I use the root mean squared error of the forecast as a percentage of average actual growth (hereafter, RMSPE) as a measure of the size of the error. A high RMSPE indicates that the simulated growth is a poor indicator of how fast a country really grew during the time period.

Second, I use the proportion of the simulation error that is due to bias to determine if a country's growth forecast is due to systematic differences between the actual and the simulated series. Theil (1961) showed that simulation error can be decomposed into three groups. The first category, which is the error due to a difference in the mean value of the simulated and actual series, is the one that is of most interest for the purposes of this paper.[10] The simulated series may actually replicate the volatility and turning points of the actual series quite closely, but if the means are different, then the forecasted rates will be consistently higher or lower than the actual rates.

I plot actual and simulated income growth for each country to determine if the simulated growth rates are higher than actual rates. I will categorize a country as an under achiever if the RMSPE of the forecast is greater than 50 percent, if 50 percent or more of the forecast error is due to systematic bias, and if forecasted growth is consistently above actual growth. After this initial categorization, I will look at the individual forecasts to identify possible groups or trends across countries.

When I combine the coefficients from equation (2) with actual factor accumulation in the 18 Latin American countries in the sample, I find that as a whole, the region grew significantly slower than a representative rich country would have with the same input accumulation. Table 2 reports the results. Average per-capita income growth in Latin American from 1955-1999 was 1.30 percent, while simulated growth was 4.49%. The RMSPE of the forecast is 517%, and the proportion of the error due to systematic bias is 71%.[11]

Figure 1 plots actual and forecasted growth for the region, with dotted lines representing two standard error bounds around the forecasts. The graph illustrates just how much the model over predicts growth in the region. Actual GDP growth in the region never approaches forecasted growth and in fact rarely reaches the lower standard error bound. The largest gap between simulated and realized growth occurs in the 1980s, where actual GDP growth was almost six percentage points below forecasted growth.[12]

While the model does not accurately simulate growth for the region as a whole, it is possible that the regional results mask large individual differences across countries. Perhaps some countries are large underachievers, while others are actually growing as fast as predicted given their input growth. Table 2 lists the country by country results.[13] In no country was actual per-capita income growth close to being as high as simulated growth, and the RMSPE of the individual forecasts ranges from 106% to more than 3,000% (in the Bolivian case). In the Nicaraguan and Venezuelan cases, it is not even possible to calculate the RMSPE since both countries' average per-capita income growth rates over the sample were negative. The proportion of the forecast error that is due to bias is also very high. Forecasted Argentine growth showed the least amount of systematic bias (at 34%), but bias percentages were above 90% for Bolivia and Honduras. The average bias was around 71%, indicating systematic differences in the means of the actual and simulated growth series.

While the individual country forecasts demonstrate that the Latin American economies are growing significantly slower than the model forecasts, there are different reasons why actual growth rates are less than simulated ones. First, some countries had levels of factor accumulation that were high enough to generate high simulated rates, while actual growth remained quite low. For example, average simulated growth in Bolivia, the Dominican Republic, Ecuador, Honduras, and Panama was 6.3%, which is almost two standard deviations higher than the average growth rate in the rich country sample.[14] Average actual growth in these countries was 1.5%, with Bolivia and Honduras recording almost zero growth over the sample (0.19% and 0.61%, respectively).[15]

The phenomenon of high input growth with little output growth indicates low productivity growth in these countries. While they were successful in marshaling the inputs necessary for rapid economic development, the efficiency with which they were put to use resulted in little output growth. The experience of these countries also casts doubt on the oft-made assertion that East Asian countries generated high GDP growth rates merely by accumulating inputs. Collins and Bosworth (1997), Krugman (1994), and Young (1994,1995), for instance, argue that East Asian growth was generated almost wholly by factor accumulation and that when the rate of accumulation slows, income growth will fall to a rate more common in developed countries. The results here show that the accumulation of inputs is a necessary but not a sufficient condition for economic growth.

Second, some countries had low levels of factor accumulation that in turn generated lower levels of simulated GDP growth. For example, the average of the individual growth forecasts for Argentina, El Salvador, Mexico, Uruguay, and Venezuela over the sample is 3.6%, which is almost one percentage point higher than the rich country average. Average realized growth over the sample was .95% for these countries, with Uruguay and El Salvador growing at less than 1% a year and Venezuela recording negative growth for the sample (-.17%).[16] Low forecasted GDP growth rates indicate that these countries had low factor accumulation relative to the other countries in the region. The fact that they still grew significantly slower than their forecasted values implies that the efficiency of resource allocation was also low.

In summary, the findings indicate that the overall results were not being driven by one or two outlier countries. Based on my definition of an under achiever as a country whose simulated growth has an RMSPE greater than 50% (and more than 50% of the forecast error is due to systematic bias), all of the countries in my sample are growing slower than their factor accumulation would predict.

Robustness Check

In this section, I investigate whether the debt crisis in the 1980s, which wrecked havoc on the Latin American economies, significantly affects the ability of the model to simulate growth rates well. I re-estimate the equation (2) for the rich country sample but exclude the 1980s. I then use those coefficients to predict growth in Latin American from 1955-1979 and 1990-1999. Table 3 reports the results of this exercise. Simulated growth rates are largely unchanged from Table 2; the average percent difference between the individual forecasts in the two tables is only -.18%. The RMSPE, on the other hand, falls by 42% when the 1980s are excluded, while the percentage of the error due to bias falls by 6.8%. This result is unsurprising given that the difference between simulated and actual growth rates in the region was greatest during the 1980s (see Figure 1). While the model more accurately simulates growth now, it still vastly over predicts average growth rates in the individual countries. No country has an RMSPE of below 50%; the only country with a bias score of less than 50% (Argentina with 14%) also has an RMSPE of 78.5%.

In summary, while Table 3 indicates that the rich country model less accurately simulated Latin American growth in the 1980s, it is clear that something more than the debt crisis is driving the results.

4. Explaining Low Productivity in Latin America

The preceding section showed that actual per-capita income growth in Latin America was consistently below simulated growth. This finding raises the question of why Latin American factor accumulation produces less output growth, or to put it another way, why productivity growth is so low in the region.

Disentangling the factors behind productivity growth is complex. Both macro and micro variables are important to the determination of productivity, and many factors (such as organizational efficiency) are difficult to quantify.[17] In this section, I discuss several factors which affect productivity rates, some of the empirical findings in the literature, and the variables I use to determine why Latin American productivity is low.[18]

Learning-By-Exporting

The act of exporting influences domestic productivity rates in several ways First, if the domestic market if small, a firm can increase the economies of scale of production by selling to the world market (see Helpman and Krugman (1985) for more on this subject). Second, unlike a closed economy where firms face little outside competition, exporting firms compete in a global marketplace and have the incentive to discover and utilize new technology to make their products better or cheaper.[19] Third, as Alam (2003) points out, increased exports loosens the foreign exchange constraint that many developing countries face, allowing firms to more easily import much needed intermediate goods.[20] Fourth, the very act of exporting puts domestic companies in contact with foreigners, who have access to different technology and know-how. Domestic firms can discover new methods of production and marketing.[21]

While there is much microeconomic support for the idea of learning-by-exporting (Bernard and Jensen 1999; Clerides, Lach, and Tybout 1998; Hallward, Iarossi, and Sokoloff (2002)), Keller (2004) notes that there is little macroeconomic evidence of such learning. One reason for this might be the fact that it is the composition, and not the total volume, of exports that matters. In an early paper, Kavoussi (1984) finds that while any type of export growth raises growth in a sub-sample of less developed countries, the effect of export growth is only positive in more advanced developing countries if a significant percent of the country's exports consist of manufactured growth. Relying on primary goods is not economically beneficial for countries as they grow richer.

To investigate whether learning-by-exporting effects explain differences in the simulation error, I include three variables in the estimation: the growth rate of exports, an interaction variable of export growth times the percent of manufactured exports, and a variable that multiplies the interaction variable by a dummy equal to one if the country is a more advanced developing country.[22]

Technological Diffusion Through Imports and Foreign Direct Investment

Imports are another important source of technological diffusion. Eaton and Kortum (1997) point out that the act of importing allows developing countries to avoid the re-creation of technologies that have already been invented in industrialized countries. Instead of investing the time and money in R&D, countries can import goods that already embody the most current technology. Even though there are no technological spillovers in this model, developing countries are better off for being able to import technologically advanced goods. Keller (2004, p.

752) points out that “for most countries, foreign sources of technology account for 90% or more of domestic productivity growth . . . (and that) . . . the G-7 countries accounted for about 84% of the world’s R&D spending in 1995.” Coe and Helpmann (1995), in a sample of 22 OECD countries from 1970-1990, show that foreign R&D is important to domestic productivity levels. More specifically, they create import-weighted R&D expenditures (based on trade with the G-5 countries) and find that foreign R&D has a strong positive effect on domestic productivity levels.[23] Note that this reasoning also applies to foreign direct investment. Countries benefit directly from any technology transfer between the domestic firm and the multinational one. In addition, the contact that domestic firms have with the more technologically advanced ones can also stimulate productivity growth.[24]

To investigate whether differences in importing explain the simulation error, I first regress the simulation error on the growth rate of imports. Later, I follow Coe and Helpmann (1995) and construct an import-weighted measure of foreign R&D expenditures to explore whether foreign productivity significantly explains differences in the simulation errors. To investigate the effects of foreign direct investment on the simulation error, I use a variable that measures the net inflows of foreign direct investment as a percentage of GDP.

Capital Openness

While the variables discussed above measure a country’s openness to the world in terms of goods and services, it is important to note that capital openness can also play an important role in overall growth and productivity (see Edison et. al. (2004) for a survey on the topic). To investigate whether capital openness explains the simulation error, I use a recently constructed index of openness by Chinn and Ito (2006). They construct the index by taking the first principal component of several variables that represent elements of capital openness, including whether a country had multiple exchange rates, there were restrictions on current account or capital account transactions, or whether there was a requirement that export revenues be turned over to the government.

Educational Quality

Another potential reason why simulated growth is higher than actual growth is that schooling quality is lower in Latin American than in the rich country sample.[25] To investigate whether difference in schooling quality is responsible for some of the simulation error, I use two measures of quality. The first, which is available over time for all the countries in my sample, is the average pupil-teacher ratio in secondary schools as a percentage of the rich country average. Lee and Barro (2001) find pupil-teacher ratios to be negatively and significantly correlated with average test scores. They argue that students tend to learn better in smaller class sizes where they have better access to the teacher, and that large classes tend to be harder to control, forcing teachers to rely more on “rote learning rather than on problem solving skills.”[26] Heynemen and Loxley (1983) find that the positive relationship between school resources and educational quality is especially strong in developing countries, while Card and Krueger (1996) find similar results for the United States.

The second empirical measure of school quality is a cross-sectional measure of international exam results and is available for the countries in the sample except Guatemala. Hanushek and Kim (2000) find that international test results are much more correlated with economic growth than variables measuring educational resources (like pupil-teacher ratios). They combine the results from six different international math and science tests administered by the IEA (International Association for the Evaluation of Educational Achievement) and the IAEP (International Assessment of Educational Progress) during 1964 and 1991 to construct an average test score for 150 countries.[27] I use the average test scores constructed by Hanushek and Kim as an additional measure of schooling quality.

Macroeconomic and Political Instability

While openness to foreign technology and global competition spur productivity growth, the internal economic and political climate can be just as important. Schatzman (2005, p. 293) points out that "by multiple classifications, the Latin American region has experienced roughly one-third of all revolutions or mass rebellions in the 20th century." Given this long history of instability, Paus (2004) argues that macroeconomic and political instability could be responsible for low productivity rates in the region.

There are several reasons that economic and political stability are harmful to economic development. Butkiewicz and Yanikkaya (2005) argue that "governments in politically unstable and polarized countries are more likely to adopt inefficient or sub optimal policies, including the maintenance of inefficient tax systems, higher current government consumption, or the accumulation of larger external debts, which, in turn, adversely affect long-run economic growth."[28] Political instability dampens new investment. Since investments are often irreversible, investors will attempt to delay investment in new technology and capital goods during periods of increased uncertainty.[29] It is also possible that politicians in unstable political environments try to delay necessary but unpopular reforms, which would discourage new investment and growth.[30]

Most empirical works on the topic of instability and economic performance usually regress measures of instability on economic growth or per-capita income levels. Edward (1998), on the other hand, finds a negative, but somewhat weak, relationship between political instability and productivity growth in a panel of 93 countries from 1960 to 1990. I use the level and standard deviation of inflation as measures of macroeconomic instability, and the incidence of civil wars and coups d'etat as proxies for political instability. Last, I include a dummy variable equal to one during the 1980s to account for the increased volatility brought about by the debt crisis.

Government Spending

While most of the empirical work studying the relationship between government spending and economic performance has emphasized the effect of government expenditures on real per-capita GDP growth, it is possible that government spending also influences productivity levels. Hansson and Henrekson (1994) list several ways in which governments can positively affect productivity, such as the elimination of market failures and the lowering of income inequality. On the other hand, government spending can significantly crowd out private investment and production, discourage work through high taxes, or increase the incentives of people to divert resources to rent-seeking activities.

The empirical relationship between government consumption and economic growth is inconclusive. Grier and Tullock (1989) and Grier (1997) both find a negative and significant correlation between the growth of government consumption expenditures and real GDP growth in the OECD. Barro (1991), using the level of consumption, also finds a negative relationship between government consumption and growth. Andrés, Doménech, and Molinas (1996) find only a weak correlation between the level of government consumption and growth in the OECD and De Gregorio (1992) finds that government consumption is only significant when literacy rates are included in the regression.

On the other hand, Hansson and Henrekson (1994) directly test the effect of government consumption on total factor productivity and show that consumption is negatively and significantly related to productivity. To determine whether government consumption negatively affects productivity in Latin America, I use a variable measuring government consumption as a percentage of GDP.

Government Type

One of the most obvious differences between the two sub-samples is the fact that most of the countries in the industrialized group have had long histories of strong democratic rule, while most Latin American countries have had only sporadic experiments with democracy (and much of that recently). Costa Rica is the only country in the Latin American sample that has been consistently democratic over the 1955-1999 period, though both Colombia and Venezuela have had consistently democratic regimes since the late 1950s. The rest of the countries in the sample have alternated between authoritarian and democratic polities, meaning that the democratic experiments that did take place during the sample period have been relatively weak. Bardhan (1993), Przeworski and Limongi (1993) and Weede (1983) use the East Asian experience to argue that authoritarian regimes are more immune to lobbying and thus better able to enact laws necessary to promote economic growth. Similarly, Diamond (1988) makes the point that authoritarian regimes are less concerned with reelection and can implement unpopular, but needed, economic reforms.[31]

The Polity IV database ranks regimes according to their level of democracy and autocracy. Both series range from zero to 10, with a 10 being the most democratic and most autocratic. An overall measure of regime type that is commonly used is a variable that subtracts the authoritarian score from the democratic one. That is, if a country is ranked 10 on the democracy scale and a zero on the authoritarian one, its overall ranking is a 10. The range of the constructed variable is from -10 (the most autocratic) to +10 (the most strongly democratic). I construct a dummy variable of authoritarian governments equal to one for countries that average a -5 or less on the scale during each five-year period.

Diversity

Besides the factors discussed above, it is possible that ethno-linguistic diversity also significantly affects productivity levels. Alesina and La Ferrara (2005) finds a negative relationship between diversity and growth and shows that a move from total homogeneity to total heterogeneity would cause a permanent two percentage point reduction in GDP growth.[32] The effect of diversity might especially be reflected in the accumulation of human capital. For instance, Alesina, Baqir, and Easterly (1999) show in a sample of U.S. cities that ethnically divided communities are less likely to agree on the location of schools and the language of instruction, with the end result being less public schooling. Easterly and Levine (1997), in a study of GDP growth in SSA, show that more diverse countries also have lower average levels of education. [33] I use Easterly and Levine's (1997) data to create three dummy variables representing high, medium, and low levels of diversity, where high (low) is defined as values that are one standard deviation above (below) the sample average.

5. Results

In this section, I examine whether the variables discussed above help to explain the gap between forecasted and actual per-capita income growth in Latin America. I also include several other variables common to the literature, such as dummies for whether a country is landlocked, has a tropical climate, or is an oil-exporter.[34] Note that larger values of the dependent variable indicate that a country is growing substantially slower than the rich country coefficients would predict. So, explanatory variables with positive coefficients are factors which are lowering productivity growth in the region.

Several of the variables discussed above have missing data which reduces the total number of observations available. I begin by estimating a regression with the variables that give me the largest number of observations. Later, I reduce the sample by adding variables with less coverage. Each time I report the results of estimating my initial specification in the newly reduced sample to determine whether any changes to the significance of these variables are due to the sample change or to the introduction of the new variable.

Equation 1 of Table 4 presents the initial model, which includes the variables with maximal coverage. I find several interesting results. The growth of imports is negative and significant at the .01 level, meaning that countries which imported more had lower levels of simulation error. The quantitative effect, however, is relatively small; an increase in the import growth by one standard deviation lowers the growth gap (that is, the difference between actual and simulated growth) by .50 percentage points. The coefficient on export growth is negative but is insignificantly related to the simulation error.

The results in equation 1 also show that government consumption spending is negatively and significantly at the .01 level, indicating that countries whose governments had large consumption expenditures also tended to have large simulation errors. An increase in government consumption by one standard deviation increases the growth gap by .55 percentage points. While the dependent variable here is not total factor productivity, this finding supports the results of Hansson and Henrekson (1994), who show a negative relationship between government consumption and productivity levels.

I also find strong evidence that ethno-linguistic diversity and government type are significantly related to the growth gap. The coefficient on low ethno-linguistic diversity is negative and significant at the .01 level, meaning that the countries in the sample with lower levels of diversity (such as Chile, Costa Rica, and the Dominican Republic) also had lower overall simulation error. Interestingly, with respect to regime type, the coefficient on the autocracy dummy is negative and significant at the .01 level, indicating that autocratic regimes have lower levels of simulation error. Moving from a non-autocratic regime to a strongly autocratic one lowers the simulation error by 1.35 percentage points.

The dummies representing tropical climates, landlocked countries, and the 1980s debt crisis are all positive and significant at the .01 level. The first two results support what many have found in the literature about climate and geography. Being a tropical country raises the simulation error by 1.27 percentage points, while being a landlocked one raises it by 2.00 percentage points. Since the debt crisis dummy in a certain sense represents macroeconomic instability, it is not surprising that it is positive and significant; the average gap between actual and predicted growth in the 1980s was 3.3 percentage points higher than in other periods.

While the coefficient on civil war is positive, it is only very weakly correlated with the simulation error. Interestingly, the coefficients on coups, inflation, and the oil exporter dummy are completely insignificant as well. I experimented with other measures of political instability, including dummy variables for the occurrence of assassinations, riots, strikes, purges, and revolutions, and found that none of them were statistically significant. In fact, in all of the estimations (and later different sample sizes), the level and standard deviation of inflation, coups, and the oil exporter dummy were never significant. Given this, I drop these variables from future estimations.

Next I investigate whether the composition of exports matters by introducing the export interaction variables into the estimation. The addition of these variables reduces the sample size to 141, so in order to effectively interpret the new results, I re-estimate equation 1 (minus inflation, coups, and the oil exporter dummy, none of which is ever statistically significant) for the reduced sample size to see if the statistical significance of any of the variables changes. Equation 2, which reports the results of this exercise, indicates that the reduction of the sample from 162 to 141 has little effect on the significant results reported above.

Equation 3 adds the export interaction variables to the regression. While overall export growth was insignificantly related to the simulation error, equation 3 provides support for Kavoussi's (1984) argument that the composition of exports matters. In poorer countries in the region, the effect of a change in exports (given some level of manufacturing) on the growth gap is positive, but only weakly significant, at the .15 level. The sign of the coefficient indicates that poor countries which export a larger percentage of manufactured goods perform worse on average.[35] The coefficient on the interaction term for the advanced country sample, however, is negative and significant at the .01 level. Richer countries which export a higher percentage of manufactured goods have lower average simulation error. Quantitatively though, the effect of this variable on the simulation error is somewhat small; an increase in the interaction variable by one standard deviation is associated with a .39 percentage point decrease in the simulation error. The inclusion of the two interaction terms does not significantly change the significance levels of the other variables, except in the case of the civil war dummy, which is now insignificantly different from zero.

In Table 5, I investigate the effect of adding educational quality variables to the estimation. Since both pupil-teacher ratio and average test scores have missing values, I report control regressions in equations 1 and 3 of Table 5. Besides raising the sign and significance of the autocracy dummy, the reduction of the sample size in itself has no significant effect on the estimation. The inclusion of the pupil-teacher ratio, however, reduces the significance level of the two export interaction variables. There is no longer any significant relationship between export growth and the simulation error in the poorer sub-sample. In the more advanced group, the coefficient is still negative but is now only very weakly significant at the .20 level. The coefficient on the dummy for tropical climates is also now insignificant. This is perhaps not surprising since the correlation between the pupil-teacher ratio (as a percentage of the rich country average) and the tropical and advanced country dummies is high. Richer, more temperate countries also had lower class sizes on average.[36]

The pupil-teacher ratio is positive and significantly related to the growth gap at the .05 level, indicating that countries with larger class sizes (relative to the rich country average) also have larger simulation error on average. An increase in the variable by one standard deviation is associated with a .599 percentage point increase in the simulation error. Equation 4 adds average test scores into the regression and finds that higher test scores are associated with lower simulation error, lending credence to the argument that educational quality is important to productivity. The statistical significance of the variable is so low though (.30 level) that no strong statements can be made about educational quality and productivity solely on the basis of average test scores.

I do not report the results to conserve space, but I estimate models that included foreign direct investment, capital openness, and foreign R&D expenditures (both in the level and as a percent of GDP) and found that none of these variables were statistically significant (although the sample is more attenuated with the inclusion of these variables). The factors which best explain the simulation error are government consumption expenditures, low ethno-linguistic diversity, climate and geography, autocracy, import growth, and the pupil-teacher ratio.[37] These variables are robust to changes in sample sizes and the inclusion of other variables.

Despite the cross-sectional variables used so far, there may still be unmeasured average differences between countries that need to be taken into account. I do this by dropping the purely cross-sectional variables and re-estimating the model with country fixed effects. The results, which are reported in Table 6, show that import growth, the pupil-teacher ratio and the autocracy dummy are all still statistically significant. The coefficient on government consumption is still positive and significant, although now only at the .15 level. While the inclusion of the fixed effects does raise the R^2 of the regression to .514, the main variables remain important factors in explaining the simulation error.

6. Conclusion

In this paper, I estimate a version of the augmented Solow model for 22 rich countries and combine those coefficients with actual factor accumulation in Latin America to simulate per-capita income growth in Latin America from 1955 to 1999. The results show that the region as a whole grew significantly slower than a representative rich country would have with identical factor accumulation. In fact, actual per-capita income growth is consistently below simulated growth for every country in the sample, indicating that the regional results are not being driven by one or two outliers. In sum, the story here is not so much that Latin America grew slowly in the last forty years, but rather that the region grew slow relative to its potential. While some of the countries in the region grew slowly because of low factor accumulation, many others had levels of factor accumulation that would have produced high growth rates in a representative rich country.

I investigate the causes behind low productivity growth in the region and find that several factors, such as import growth, autocracy, educational quality, geography and climate, ethno-linguistic diversity, and the composition of exports are all important to explaining the gap between actual and simulated growth. Some of these factors, like geography and climate, are impossible for countries to change. Others, like ethno-linguistic diversity, should not be changed. However, there are positive implications of the findings here. Many of the countries have had impressive factor accumulation that could have led to very fast GDP growth if it was combined with higher productivity. Policies which emphasized educational quality or technological diffusion, such as continuing the removal of trade barriers, could have a large effect on future economic growth in the region.

Table 1. Relative Per-Capita Incomes in 1955 and 2000*

	1955	**2000**	**% change**
Argentina	91.3	50.3	- 44.9
Bolivia	34.8	11.6	- 66.7
Brazil	26.2	30.6	+ 16.9
Chile	46.9	42.2	- 10.2
Colombia	33.3	22.9	- 31.2
Costa Rica	43.0	24.9	- 41.9
Dominican Republic	17.9	22.4	+ 25.4
Ecuador	24.7	14.7	- 40.5
El Salvador	42.6	18.9	- 55.7
Guatemala	27.6	16.6	- 39.8
Honduras	20.4	8.7	- 57.2
Mexico	46.3	37.3	- 19.5
Nicaragua	37.2	7.5	- 79.8
Panama	27.9	25.8	- 7.5
Paraguay	31.9	19.9	- 37.7
Peru	40.6	19.5	- 51.9
Uruguay	84.8	40.9	- 51.8
Venezuela	97.4	27.3	- 71.9
Average (median) per-capita income, by region			
Latin America	43.0 (35.9)	24.6 (22.6)	- 37.0 (-41.2)
East Asian	21.9 (19.4)	81.4 (77.0)	+ 272.3 (247.9)
Sub-Saharan Africa	17.3 (12.5)	9.59 (5.2)	- 44.0 (-59.2)

* Relative per-capita income is defined as a country's average per-capita income in a particular year as a percentage of the average per-capita income in the rich country sample. All data are taken from the Penn World Tables, Mark 6.1.

Table 2. Forecasting Per-Capita Growth in Latin America

Country	Actual Growth	Simulated Growth	RMSE*	RMSPE	% of error due to systematic bias
Argentina	1.24	3.16	3.63	292.7	34
Bolivia	0.19	6.49	6.63	3489.5	93
Brazil	2.85	5.33	3.04	106.7	65
Chile	2.26	5.20	3.93	173.9	54
Colombia	1.73	5.22	3.72	215.0	89
Costa Rica	1.48	4.57	3.52	237.8	85
Dom. Rep.	2.91	6.18	3.74	128.5	71
Ecuador	1.39	6.38	5.79	416.5	75
El Salvador	0.77	4.07	3.86	501.3	75
Guatemala	1.32	4.45	3.38	256.1	81
Honduras	0.61	6.59	6.19	1014.8	92
Mexico	1.97	3.91	2.41	122.3	59
Nicaragua	-1.16	5.14	7.44	*	68
Panama	2.41	5.73	3.92	162.7	74
Paraguay	1.71	4.97	4.07	238.0	73
Peru	1.01	5.49	5.33	527.7	74
Uruguay	0.96	3.82	3.78	393.8	59
Venezuela	-0.17	3.06	4.28	*	61
Average	1.30	4.49	4.37	517.3	71.2

Table 3. Forecasting Per-Capita growth in Latin America without the 1980s

Country	Simulated Growth	% Δ*	RMSPE	% Δ	Bias	% Δ
Argentina	3.17	0.3	78.5	-73.2	14	-58.8
Bolivia	6.50	0.2	797.3	-77.2	93	0.0
Brazil	5.66	6.2	66.1	-38.1	56	-13.8
Chile	5.12	-1.5	146.7	-15.6	44	-18.5
Colombia	5.19	-0.6	200.0	-6.9	87	-2.2
Costa Rica	4.48	-1.9	132.5	-44.3	93	9.4
Dom. Rep.	6.16	-0.3	85.3	-33.6	63	-11.3
Ecuador	6.60	3.4	257.8	-38.1	68	-9.3
El Salvador	3.77	-7.4	195.7	-60.9	73	-2.7
Guatemala	4.48	0.7	119.5	-53.3	82	1.2
Honduras	6.59	0.0	665.6	-34.4	90	-2.2
Mexico	4.04	3.3	61.5	-49.7	57	-3.4
Nicaragua	4.91	-4.4	*	*	63	-7.4
Panama	6.05	5.6	95.7	-41.2	83	12.2
Paraguay	4.88	-1.8	247.8	4.1	67	-8.2
Peru	5.55	1.1	192.2	-63.6	79	6.8
Uruguay	3.69	-3.4	197.9	-49.7	59	0.0
Venezuela	2.98	-2.6	204.5	*	52	-14.8
Average	4.99	-0.18	220.3	-42.2	67.9	-6.8

% Δ represents the percent change in the numbers from Table 2.

Table 4. Explaining the Simulation Error

Variable	Eq. 1	Eq. 2[a]	Eq. 3
Intercept	1.85	1.64	1.72
	(2.7)	(2.1)	(2.3)
Export Growth	-0.007	-0.008	*
	(1.0)	(1.2)	
Export growth*manufacturing	*	*	0.001
			(1.6)
Export growth*manufacturing*	*	*	-0.002
income dummy			(2.3)
Import growth	-0.05	-0.06	-0.06
	(2.8)	(2.9)	(3.1)
Govt. consumption spending	0.08	0.10	0.10
(as a % of GDP)	(2.8)	(3.6)	(3.5)
Civil war dummy	0.76	1.07	0.84
	(1.5)	(2.0)	(1.6)
Coups d'etat	0.13	*	*
	(0.5)		
Inflation	0.0004	*	*
	(1.2)		
Low ethno-linguistic diversity	-1.21	-1.32	-1.25
	(2.9)	(2.9)	(2.9)
Autocracy dummy	-1.35	-1.11	-1.08
	(3.1)	(2.3)	(2.3)
Landlocked dummy	2.00	1.83	1.63
	(3.4)	(2.9)	(2.6)
Tropical dummy	1.27	2.30	1.11
	(2.8)	(2.6)	(2.4)
Debt crisis dummy	1.36	1.19	1.40
	(3.0)	(2.4)	(2.9)
Oil Exporter Dummy	-0.39	*	*
	(0.9)		
R^2	.407	.409	.434
N	162	141	141

Numbers in parentheses are t-statistics.

[a] In equation 2, I reduce the sample to 141 to be able to effectively interpret the results in equation 3 (which adds the export interaction variables).

Table 5. Explaining the Simulation Error, Including Measures of Educational Quality

Variable	**Eq. 1**	**Eq. 2**	**Eq. 3**	**Eq. 4**
Intercept	1.71	1.31	2.05	3.45
	(2.2)	(1.7)	(2.6)	(2.3)
Export growth*manufacturing	0.001	0.001	0.002	0.001
	(1.6)	(0.6)	(1.7)	(1.4)
Export growth*manufacturing*	-0.002	-0.001	-0.002	-0.002
income dummy	(2.3)	(1.3)	(2.3)	(2.0)
Import growth	-0.05	-0.06	-0.06	-0.06
	(2.7)	(2.8)	(3.1)	(3.1)
Govt. consumption spending	0.10	0.09	0.09	0.08
(as a % of GDP)	(3.6)	(3.3)	(3.0)	(2.6)
Civil war dummy	0.86	0.76	1.24	1.14
	(1.6)	(1.5)	(2.0)	(1.9)
Low ethno-linguistic diversity	-1.28	-1.44	-1.32	-1.36
	(2.9)	(3.3)	(3.0)	(3.1)
Autocracy dummy	-1.29	-1.16	-1.21	-1.22
	(2.7)	(2.4)	(2.4)	(2.4)
Landlocked dummy	1.66	1.60	1.63	1.43
	(2.6)	(2.6)	(2.5)	(2.2)
Tropical dummy	0.98	0.56	1.08	0.93
	(2.0)	(1.1)	(2.3)	(1.9)
Debt crisis dummy	1.43	1.19	1.29	1.33
	(2.9)	(2.4)	(2.5)	(2.6)
Pupil-teacher ratio	*	0.01	*	*
		(2.2)		
Average test score	*	*	*	-0.02
				(1.1)
R^2	.442	.463	.449	.455
N	136	136	133	133

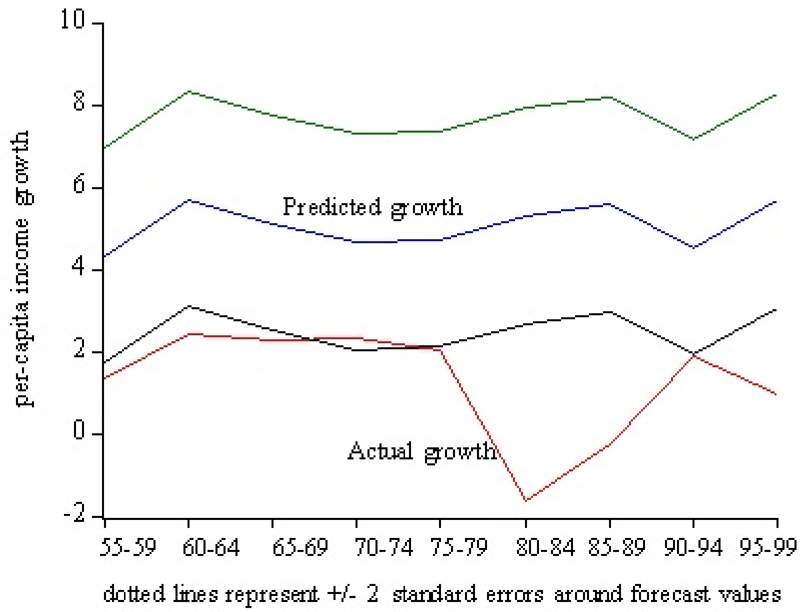
Numbers in parentheses are t-statistics.

Table 6. Explaining the Simulation Error, Including Country Fixed Effects

Variable	**Eq. 1**
Intercept	2.01
	(2.0)
Export growth*manufacturing	0.0003
	(0.4)
Export growth*manufacturing* income dummy	-0.001
	(0.7)
Import growth	-0.08
	(4.2)
Govt. consumption spending (as a % of GDP)	0.06
	(1.6)
Civil war dummy	1.27
	(1.8)
Autocracy dummy	-1.11
	(2.0)
Pupil-teacher ratio	0.013
	(2.2)
R^2	.514
N	136

Numbers in parentheses are t-statistics.

Figure 1. Actual and Predicted Per-Capita Income Growth in Latin America



Appendix A
Summary Statistics

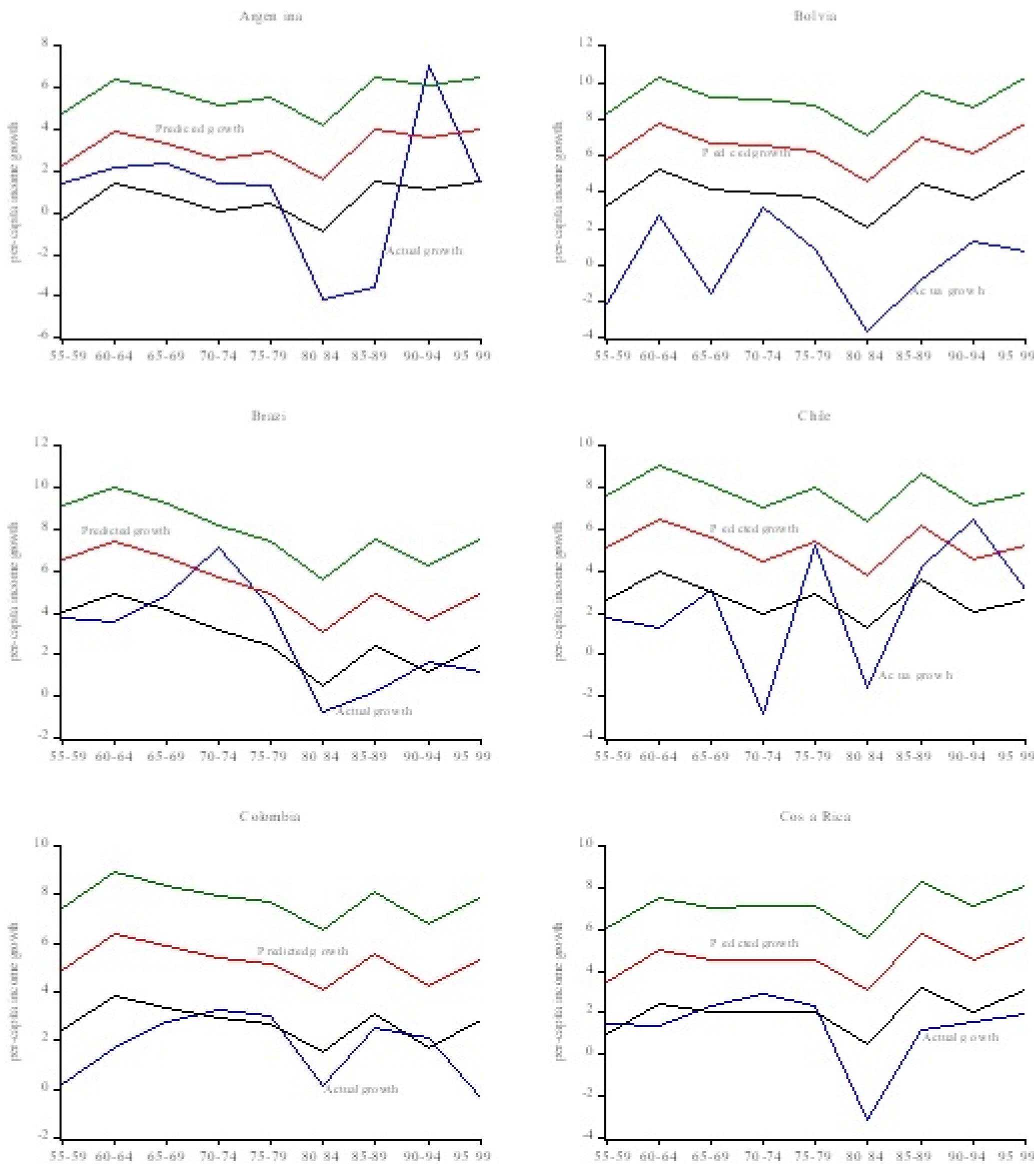
Rich Countries	**Mean**	**Standard Deviation**	**N**
Per-capita income growth	0.028	0.018	195
Population growth	0.007	0.005	195
Investment (% of GDP)	26.05	5.08	195
% Secondary Schooling	0.40	0.18	198
Latin America			
Per-capita income growth	0.013	0.026	162
Population growth	0.024	0.008	162
Investment (% of GDP)	16.03	6.84	162
% Secondary Schooling	0.18	0.11	162
Export growth	13.79	27.7	162
Import growth	10.87	10.8	162
Govt. consumption spending	18.5	6.8	162
Ethno-linguistic diversity	0.26	0.21	162
Autocrat dummy	0.22	0.41	162
Tropical dummy	0.78	0.42	162
Landlocked dummy	0.11	0.32	162
Debt crisis dummy	0.22	0.42	162
Coups	0.32	0.69	162
Civil war	0.15	0.36	162
Inflation	115.4	456.6	162
Oil exporter dummy	0.30	0.46	162
Manufacturing (% of exports)	18.77	15.6	141
Pupil-Teacher Ratio	113.9	57.3	156
Average test result	67.1	14.4	153
Foreign direct investment	1.45	1.70	108
Capital Openness	-0.11	1.45	108
Foreign R&D expenditures	6.79E+12	2.79E+12	72
Foreign R&D as a % of GDP	1.22	0.36	72

Appendix B
Years of Secondary Schooling

# of Yrs	**Rich Countries**	**Latin America**
4	none	Bolivia
		Chile
5	Ireland	Argentina
	Portugal	Brazil
		Costa Rica
		El Salvador
		Honduras
		Venezuela
6	Australia	Colombia
	Belgium	Dominican Republic
	Canada	Ecuador
	Denmark	Guatemala
	Finland	Mexico
	France	Nicaragua
	Greece	Panama
	Japan	Paraguay
	Netherlands	Peru
	Norway	Uruguay
	Spain	
	Sweden	
	United States	
7	Switzerland	none
	United Kingdom	
	Iceland	
	New Zealand	
8	Austria	none
	Italy	
9	Germany	none

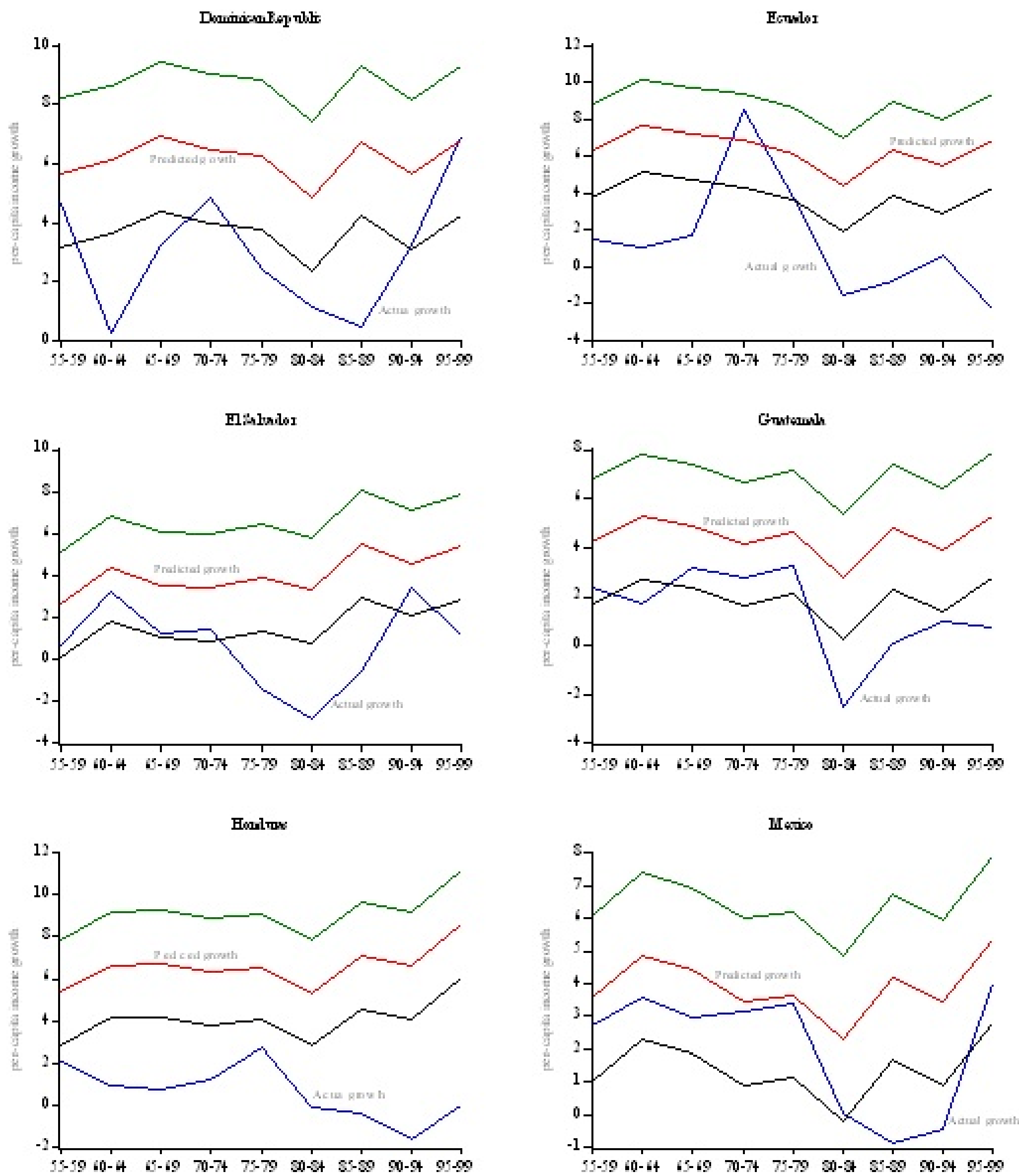
Appendix C

Actual and Predicted Per-Capita Income Growth in Individual Countries



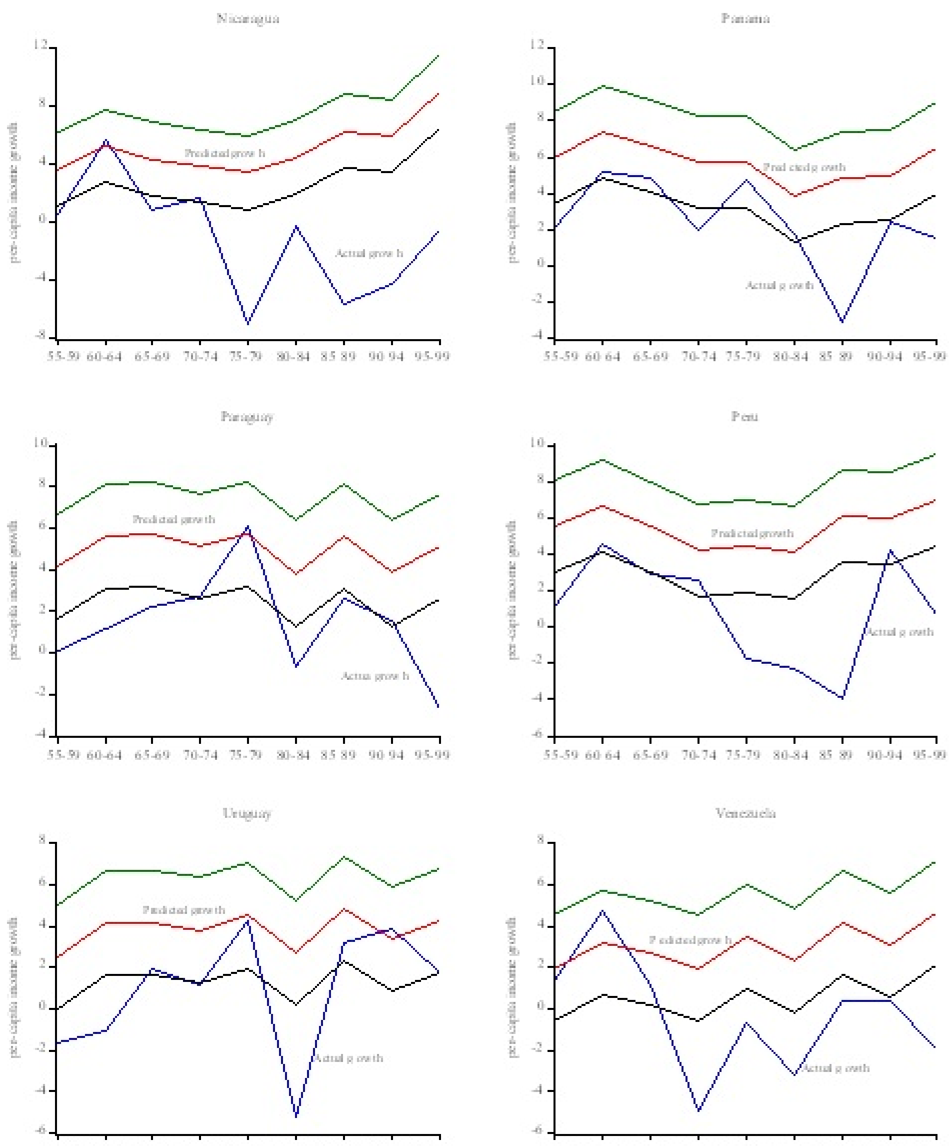
the dotted lines represent +/- 2 standard errors around forecast values

Appendix C
Continued



the dotted lines represent +/- 2 standard errors around forecast values

Appendix C
continued



the dotted lines represent +/- 2 standard errors around forecast values

Appendix D
Description of Variables in Section IV

Variable	**Description**	**Source**
Export growth	5 year averages of the annual growth rate of exports	Banks (2006)
Import growth	5 year averages of the annual growth rate of imports	Banks (2006)
Govt. consumption	5 year averages of government consumption expenditures as a percentage of GDP	Heston, Summers, and Aten (2002)
Diversity	ethno-linguistic fractionalization in 1960	GDNGD*
Autocracy	a dummy variable equal to 1 if a country averages a -5 or lower on the Polity II score for a 5-year period	Marshall and Jaggers (2002)
Tropical dummy	equal to 1 if a country is considered tropical	GDNGD
Landlocked dummy	equal to 1 if a country is landlocked	GDNGD
Coups	the number of coups in each 5-year period.	CS** and Zuljan (2001)
Civil war	equal to 1 if a country has suffered civil war in a 5-year period.	Sarkees (2000)
Inflation	average inflation rate for each 5-year period	Heston, Summers, and Aten (2002)
Oil Exporter	dummy equal to 1 if fuel exports (as a % of merchandise exports) are greater than fuel imports (% of merchandise imports)	World Dvlpt. Indicators
Manufacturing	5 year averages of manufacturing exports as a % of merchandise exports	World Dvlpt. Indicators
Pupil-teacher ratio	pupil-teacher ratio as a percentage of rich country average, available every 5 years	Lee and Barro (2001)

Appendix D

Avg. test results	average of 8 different international science and math exams administered during the sample (international mean changes over time according to avg. US performance)	Hanushek and Kimko (2000)
Foreign Direct Investment	5 year averages of net inflows (as a % of GDP)	World Dvlpt. Indicators;
Capital Openness	5 year averages of the principal component of several variables that represented elements of capital openness	Chinn and Ito (2006)
Foreign R&D	expenditures on R&D by each of the G-5 countries, by level and also as a percentage of GDP, weighted by import shares	Lederman and Saenz (2003); Direction of Trade (IMF)

*GDNGD stands for the Global Development Network Growth Database
**CS stands for Country Studies/Area Handbook Series

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Notes

1. See Fernández-Arias and Montiel (1997), Easterly (2001) and Rodrik (2004) for more on economic reform and growth in Latin America in the 1990s.

2. Table 1 displays the evolution of average relative per-capita income for various developing regions from 1955-2000, where relative income is defined as average per-capita income in a region as a percentage of average per-capita income in a sample of rich countries. I use the term "rich country sample" instead of OECD countries because the membership of the OECD has changed dramatically since 1955 and indeed no longer includes just rich, industrialized countries.

3. The rich country sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. The Latin American sample includes Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Paraguay, Uruguay, and Venezuela.

4. Easterly, Loayza, and Montiel (1997), in an evaluation of post-reform growth in Latin America, argue that regional performance has not been disappointing. Specifically, they use the fitted values of a regression of per-capita income growth for 70 countries to predict the change in growth rates from 1986-90 to 1991-93 and find that, if anything, Latin America is performing better than might be expected. My paper is different from theirs in several ways: (1) I investigate the convergence (or divergence, in this case) of Latin American growth from 1960-1999 and do not focusing solely on post-1990 reform; (2) I use a representative industrialized country as my benchmark instead of a sample of 70 countries around the world; and (3) my regression is based on Mankiw, Romer, and Weil's estimation of the Solow growth model.

5. See Caselli, Esquivel, and Lefort (1996). If investment is an endogenous regressor, the results produced with OLS estimation will be inconsistent.

6. See Grier and Tullock (1989) for a justification of using 5-year intervals instead of averaging over long period of time.

7. See Appendix A for the summary statistics of all variables used in the paper.

8. Instead of entering in the raw number though, I transform it to account for the fact that different countries make the primary-secondary schooling divide at different years. As Appendix B shows, a student who successfully completes four years of secondary schooling in Bolivia and Chile would have graduated from secondary education. On the other hand, a German student who completes 4 years of secondary schooling is less than 50% done with total secondary education (assuming he or she stays in school and graduates). I divide the data on average years of secondary schooling by the possible number of years of secondary schooling.

9. As a direct test for first-order serial correlation in the error term, I first estimate equation (1) using least squares and calculate a common autocorrelation coefficient for the residuals of a panel of the industrialized countries. The coefficient was equal to .11, which means that first-order autocorrelation is probably not a problem.

10. The second cause of simulation error is when the two series have different volatilities. The third group is a residual category which captures unsystematic error. Given that the model does not exactly replicate actual growth, the performance of the model in predicting the data is better when all or the majority of the error is unsystematic. Pindyck and Rubinfeld (1991, p. 341) argue that the ideal distribution of the error should be 0% from the first two categories and 100% from the last one.

11. In contrast, when Grier (2003) performed a similar exercise for the East Asian region, she finds that the overall RMSPE was around 50% and that the proportion of the error due to bias was very low (2%).

12. While the gap narrows to 4.5 percentage points in the 1990s, this spread is quite a bit higher than that found in the 1960s and 1970s (3.8 and 3.1 percentage points, respectively). Thus, it is perhaps not surprising that Latin Americans are increasingly frustrated about the lack of growth after economic reform in the 1990s.

13. Appendix C plots actual and forecasted growth for the individual countries, with dotted lines representing two standard error bounds around the forecasts.

14. Average real per-capita growth in the rich country sample was 2.8 and the standard deviation was 1.79.

15. Appendix C shows that actual growth rates seem to be converging to forecasted rates in the case of the Dominican Republic in 1999, but only once does actual growth equal or exceed forecasted growth for this group of countries (Ecuador in 1975). Peruvian growth rarely surpasses the lower standard error bound, while growth rates in Bolivia and Honduras never do.

16. The model fails to predict the sharp economic downturns in the 1980s in Argentina and Uruguay. For the period 1980 to 1990, the average simulated growth for Argentina was 2.81%, the actual average growth rate was -3.33%. The model does predict a downturn in the Uruguayan economy in the early 1980s, but not nearly as precipitous as the contraction that actually took place (around -5%). Realized growth rates in Venezuela were actually higher than forecasted rates in the late 1950s, but fell after that and have remained consistently below even the lower bound of two standard errors.

17. See Klenow and Rodríguez-Clare (2005) for a nice discussion on the subject of externalities, productivity and economic growth.

18. See Appendix D for a description of the variables and their sources.

19. See Tyler (1981) for more on the idea of learning-by-exporting. Of course there is the potential here for reverse causation if only the most productive firms are choosing to export.

20. For more on this subject, see Esfahani (1991) and Serletis (1992)

21. As Alam (2003, p. 88) puts it, "the possible sources of this spillover include accelerated technological improvement due to increased competitiveness, managerial and entrepreneurial efficiency, better forms of organization and labor training, changing attitudes and knowledge about technology and international markets."

22. The World Bank classifies countries according to income, but the classification is then retroactively applied to the data. That is, a country that has suffered poor income growth in the past thirty years may have been previously categorized as an upper middle-income country but because it is poorer now, it is now in the lower middle income category. To create a dummy variable that moves over time, I used the World Bank formula (constructed by comparing the percentage differences in income between groupings in the 2004 classification) to go back and classify the individual countries year by year.

23. Coe and Helpmann (1997) find similar results in a sample of developing countries.

24. See Markusen (2002) for more on the argument that foreign direct investment fosters technology diffusion. Keller (2004) notes that many papers on the topic have failed to find a significant relationship between firm productivity and foreign direct investment, but argues that most of this evidence is from the microeconomic level (Hanson 2001; Görg and Greenaway 2002).

25. Note that the same argument could be made about investment, namely that corruption or inefficiency makes investments less productive in Latin American than in the industrialized sample. I experimented with adding a variable measuring corruption in the next section but it was only available after 1980 and was never significant.

26. See Psacharopoulos and Woodhall (1985) for a discussion of the factors behind educational quality.

27. Note that the test scores for many of the 150 countries are not directly observed and instead had to be predicted from their growth model.

28. There is a large literature on this issue. Some examples include Persson and Svensson 1989; Tabellini and Alesina 1990; Cukierman, Edwards, and Tabellini 1992.

29. For more on the relationship between investment and instability, see for example: Benhabib and Spiegel (1997), Gyimah-Brempong and Traynor (1996) and Alesina and Perotti (1996)). More recently, Grier and Grier (2005), show in the case of Mexico that higher average inflation raises inflation uncertainty, and that the overall net effect of average inflation on output growth is negative.

30. See Butkiewicz and Yanikkaya (2005), Alesina and Drazen (1991), and Dollar and Svensson (2000).

31. See Ali and Said Isse (2004) for a recent discussion of these issues.

32. On the other hand, Lian and Oneal (1997) show in a 98 country sample from 1960-1985 that ethno-linguistic diversity is not significantly related to per-capita income growth. Similarly, Nettle (2000) argues that there is no robust statistical evidence showing that diversity and growth directly effect one another.

33. Grier (2004) argues that diversity is unlikely to have a monotonic effect on education. In fact, she finds a positive and significant relationship between high levels of diversity and human capital accumulation in Sub-Saharan Africa.

34. See Perala (2003) for more on the complex relationship between economic growth and natural resources.

35. Countries can change categories over time based on their relative incomes, but the countries that are consistently in the poorer group include Bolivia and Paraguay. Argentina, Brazil, Chile, Mexico, Panama, Uruguay, and Venezuela are always in the richer sub-group. The other countries change categories at least once during the sample.

36. The correlation coefficient between the pupil-teacher ratio and tropical is .36, while the correlation between it and the income dummy is -.46.

37. The composition of manufacturing is also important, although it is not as robust as the other variables. The pupil-teacher ratio dominates this interaction term when the two are in the specification together.