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The Latin American Development Problem: An Interpretation

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Abstract

By international standards, gross domestic product (GDP) per capita in Latin America is low: around one fourth of that of the United States. Moreover, in the last five decades, Latin America has failed to catch-up in wealth to the level of the United States while other countries at similar or even lower stages of development have been successful. The failure to attain higher levels of relative income represents what I call the development problem in Latin America. Using a development accounting framework, I find that the bulk of the difference in GDP per capita between Latin America and the United States is accounted for by low GDP per hour and, in particular, low total factor productivity (TFP) in Latin America. I estimate that to explain the difference in GDP per hour, TFP in Latin America must be around 60 percent of that in the United States. I then consider a model with heterogeneous production units where institutions and policy distortions lead to a 60 percent productivity ratio between Latin America and the United States. Removing the barriers to productivity can increase long-run GDP per hour in Latin America by a factor of 4 relative to that of the United States. This increase is equivalent to 70-years worth of post-world-war-II economic development in the United States.

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1 Introduction

The economic growth experience of Latin America in the last five decades constitutes one of the most interesting episodes in modern development economics. In 1960, gross domestic product (GDP) per capita in Latin America relative to that of the United States was 30 percent. By 2009 this statistic had fallen to 23 percent. Not only income is low in Latin American countries, but also it has fallen relative to that of the technological leader. This poor economic performance contrasts sharply with other regions and countries at similar or lower stages of economic development in 1960.[1] While many countries in Latin America contribute to this relatively poor performance, some countries stand out such as Argentina, Bolivia, Peru, and Venezuela. Broadly speaking, the facts of low and declining relative income motivate what I call the Latin American development problem. In this article, I provide an assessment and interpretation of the poor economic performance in Latin America.

Economic performance in Latin America has often been viewed as the outcome of macroeconomic adjustment as many economies in the region have suffered numerous economic crises. In fact, high volatility in economic activity is a prevalent feature of these economies and may be important in explaining their poor economic performance.[2] Because high volatility in economic activity in the region often masks the underlying flat or negative trends in economic performance (see for instance some country examples in Figure 1), I will focus on trended data on GDP per capita. Using data for 10 Latin American countries, I report the following facts about the development problem in Latin America.[3] First, between 1960 and 2009 Latin

[1]Duarte and Restuccia (2006) report that in 1960 the average Latin American country represented 34 percent of the GDP per worker in the United States. It also represented more than 2.4 times the GDP per worker of the average country in Asia and about half the GDP per worker of Western Europe. By 2000, the same Latin American countries represented about 25 percent of the GDP per worker in the United States. Whereas Latin American countries lost some ground in productivity relative to that of the United States, Asia overtook Latin America's labor productivity (Latin America being 73 percent of Asia) and Western Europe increased its advantage to more than 3 times the level of productivity in Latin America.

[2]There is a large literature on volatility and growth. This literature finds a strong empirical negative relationship between volatility and long-run growth, see for instance Ramey and Ramey (1995), Hnatkovska and Loayza (2005), Aghion and Banerjee (2005), among many others.

[3]The countries are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and

America features low and declining GDP per capita relative to the United States. Second, in decomposing GDP per capita I find that none of the difference is explained by differences in the quantity of work hours, while less than 20 percent of the difference is explained by a lower employment to population ratio in Latin America. The bulk of the difference in income steams from low GDP per labor hour (labor productivity) in Latin America relative to the United States. Third, in decomposing GDP per hour using an aggregate production function that includes physical and human capital as inputs, I show that almost none of the difference is explained by systematic differences in the physical capital to output ratio and that some difference is explained by differences in the quality and quantity of human capital. More importantly, I show that most of the difference steams from differences in total factor productivity (TFP). This emphasis on the role of TFP in explaining the economic performance of Latin America is consistent with the earlier analysis of Elias (1992), Solimano and Soto (2006), Cole et al. (2005), among others. I argue that in the context of a model with physical and human capital accumulation, TFP in Latin America needs to be only about 60 percent that of the United States to account for a 25 percent ratio of GDP per hour. Fourth, I report labor productivity in agriculture, industry, and services and argue that aggregate productivity differences between Latin America and the United States are not the result of sector-specific distortions. Therefore, I seek for an economy-wide explanation for low productivity in Latin America.

Given these facts, I then consider a model where institutions and policy distortions in Latin America cause relative measured TFP to be 60 percent of the United States. The model follows Restuccia and Rogerson (2008) in extending the neoclassical growth model to allow for establishment heterogeneity. This framework has been extensively used in empirical applications of productivity differences across countries (see for instance Hsieh and Klenow, 2009; Bartelsman, Haltiwanger, and Scarpetta, 2012; Alfaro, Charlton, and Kanczuk, 2007; Pages, 2010; among many others). A related framework has been used for more specific

Venezuela. See the data appendix for more details.

applications to the development problem such as size-dependent policies (Guner, Ventura, and Xi, 2008), financial frictions (Greenwood et al. 2010), restrictions to foreign direct investment (Burstein and Monge, 2009), informality (Leal, 2010), among many others. In the model, establishments differ on their factor productivity and reallocation of capital and labor across establishments leads to measured TFP differences. The novelty in the analysis in this paper is that, in addition, upon entering establishments invest in the likelihood of higher productivity draws from an invariant distribution. As a result, institutions and policy distortions not only misallocate resources across establishments, as emphasized in the existing literature, but also shift the distribution of establishments to lower productivity levels. This feature of the model is broadly consistent with the micro data for Latin American countries where the distribution of efficiencies among plants in the manufacturing sector is skewed to the left towards low productivity units (see Pages, 2010). The class of institutions and policy distortions that I consider is broad and abstract. In particular, I consider two broad sets of policies. First, I quantify the impact of institutions that cause an increase in the cost of entry for establishments. There are many examples of these costs (see for instance De Soto, 1986 and Djankov et al. 2002). Second, I quantify the impact of idiosyncratic distortions that cause a reallocation of resources from the most productive to the less productive establishments. The type of policies that would effectively cause such a reallocation is also very large including subsidies to public enterprises, trade and labor restrictions, taxation, competition barriers and excessive regulations, among many others. In the calibrated model, I find that these institutions and policy distortions lead to a TFP ratio between the distorted and undistorted economies in the range of 60 to 70 percent. As a result, removing productivity barriers in Latin America can lead to an increase in relative long-run labor productivity of a factor of 4. Under one metric, this increase in labor productivity is equivalent to 70 years worth of post-world-war-II economic development in the United States.

There is an extensive literature analyzing different aspects of the development experience in Latin America. This literature is too vast to reference here but see for instance Solimano and Soto (2006) and the references therein. There is also a recent literature studying country-specific experiences using quantitative models (see for instance Bergoeing et al., 2002; Kydland and Zarazaga, 2002; Cole, et al., 2005; among others). Cole et al. (2005) emphasize the importance of competition barriers in explaining the low productivity levels in Latin America. Many Latin American experiences have been studied in the context of depression episodes such as Mexico and Chile in the 80's (see for instance Bergoeing et al., 2002, Bergoeing et al., 2004). While similar forces may lead to TFP to be below trend, the emphasis in this paper is in explaining the low productivity levels in Latin America.

The paper is organized as follows. In the next section I document the basic facts about the development problem in Latin America. I decompose GDP per capita to show that low labor productivity (and in particular low TFP) is at the core of the development problem in Latin America. Section 3 describes a model of TFP and calibrates it to data for the United States. In section 4 I perform a quantitative analysis of institutions and policy distortions in Latin America with a discussion of policy implications. I conclude in section 5.

2 Some Facts

In this section, I document a set of facts about gross domestic product (GDP) per capita and related factors in order to establish what I call the development problem in Latin America. The analysis will serve to guide the search for an explanation of the development problem in Latin America. The period of analysis covers 1960 to 2009. I will focus on long-run trends, therefore, the data are trended using the Hodrick-Prescott filter with a smoothing parameter $\lambda = 100$. For a detailed description of the data and sources see the Appendix.

2.1 GDP per Capita

The total amount of goods and services produced in a country within a specified period of time provides a summary measure of wealth in a nation. Between 1960 and 2009, GDP per capita has grown in all Latin American countries. But the growth in GDP per capita has not allowed Latin American countries to catch up to the level of more developed economies. I take the United States, which has observed a high level and stable growth rate of GDP per capita for most of the 20th century, as the benchmark against which to compare the economic performance in Latin America. Relative to that of the United States, GDP per capita in Latin American countries is low and has been declining. Table 1 summarizes these facts. In 1960 Latin America observed 30 percent of the GDP per capita of the United States. By 2009 this statistic has declined to 23 percent. This relative decline is highly influenced by the negative economic performances of Venezuela, Peru, Bolivia, Argentina, and Uruguay. Figure 2 reports the evolution of GDP per capita in Latin American countries relative to the United States between 1950 and 2009. Relative GDP per capita has been stagnant or declining for Latin American countries during this period. With the exception of Chile in recent years, no other Latin American country has grown at rates substantially above the ones in the United States. This occurs despite Latin American countries observing levels of GDP per capita below that of the United States. Even though there is substantial room for catch-up in income to the United States, this process has not occurred for Latin American countries. This performance contrasts sharply with the evolution of GDP per capita in other countries at a similar stage of development (see Duarte and Restuccia, 2006 for a recent comprehensive documentation of these different growth experiences).

Table 1: GDP per Capita in Latin America

Country	Relative GDP per capita 1960	Relative GDP per capita 2009	Annualized Growth (%)
Argentina	0.48	0.33	1.32
Bolivia	0.14	0.09	1.15
Brazil	0.19	0.20	2.17
Chile	0.38	0.42	2.32
Colombia	0.22	0.22	2.11
Ecuador	0.20	0.15	1.61
Mexico	0.27	0.25	1.94
Peru	0.26	0.16	1.03
Uruguay	0.45	0.31	1.37
Venezuela	0.82	0.32	0.17
Latin America	0.30	0.23	1.53
USA	1.0	1.0	2.10

2.2 Decomposing GDP per Capita

What is the source of the poor economic performance of Latin American economies? We can look beyond the aggregate evolution of GDP per capita and decompose it into three factors as follows. At each date, GDP per capita can be written as:

$$\frac{Y}{P} = \frac{Y}{nE} \times \frac{E}{P} \times n,$$

where Y/P is GDP per capita, E/P is the employment to population ratio, n is hours per worker, and Y/nE is labor productivity (GDP per labor hour). Hence, the ratio of GDP per capita between any two countries i and j is given by:

$$\frac{(Y/P)_i}{(Y/P)_j} = \frac{(Y/nE)_i}{(Y/nE)_j} \times \frac{(E/P)_i}{(E/P)_j} \times \frac{n_i}{n_j}.$$

In words, relative GDP per capita between countries i and j is the product of the ratio of labor productivity, the ratio of employment to population, and the ratio of hours worked. Hence, a low relative GDP per capita can be the result of low labor productivity, low employment rates, low hours or any combination of these factors. The evidence from Table 1 indicates that the factor difference in GDP per capita between Latin America and the United States is roughly 1 to 4 (or 25 percent). Which variables in the above decomposition explain a factor of 4-fold difference between GDP per capita in the United States and Latin America? I describe these differences in turn.

Hours I first examine whether hours of work can account for the low relative levels of GDP per capita in Latin America. There are important limitations in collecting and comparing hours of work across a wide range of countries. Nevertheless the available data suggest that hours of work cannot explain the low relative levels of GDP per capita in Latin America. I use data on annual hours per worker collected by the Conference Board and Groningen Growth and Development Centre (2010) from a number of sources. Figure 3 documents the available time series data for a number of Latin American economies and the United States. As the figure shows, Latin American countries systematically work more hours than the United States (about 7 percent more hours in 1960 and 11 percent more hours in 2009). Over time, with the exception of Mexico, hours of work have declined for all countries but hours of work remain higher for Latin American countries relative to the United States. As a result, hours of work not only contribute to a small difference between Latin America and the United States, but also hours contribute negatively to explaining low relative GDP per capita in Latin America. I conclude then that an explanation of low and declining relative GDP per capita in Latin America cannot be based on differences in hours of work.

Employment to Population Ratio I next examine whether differences in the employment to population ratio can explain the low relative GDP per capita in Latin America.

Table 2 reports the employment to population ratio across Latin American countries and the United States in 1960 and 2009. While the employment ratio is higher for the United States than most Latin American countries, the difference in the employment ratio can only explain less than 20 percent of the difference in GDP per capita across Latin America and the United States. To see this, notice that the ratio of the employment to population between Latin America and the United States is 0.82 to 0.87 while the ratio of GDP per capita is 0.30 to 0.23, therefore the employment ratio explains between 17 percent of the GDP per capita in 1960 (log(0.82)/log(0.30)) and 10 percent in 2009 (log(0.87)/log(0.23)).

Table 2: Employment to Population Ratio

Country	1960	2009
Argentina	0.39	0.38
Bolivia	0.33	0.40
Brazil	0.38	0.48
Chile	0.31	0.45
Colombia	0.28	0.40
Ecuador	0.27	0.37
Mexico	0.25	0.39
Peru	0.33	0.37
Uruguay	0.32	0.47
Venezuela	0.29	0.35
Latin America	0.31	0.40
USA	0.38	0.46
Ratio (LA/US)	0.82	0.87

Labor Productivity The previous analysis leaves us with one factor explaining the bulk of differences in GDP per capita. That factor is labor productivity or GDP per labor hour. Since I have already established that hours differences are small and stable, then the bulk of difference in GDP per capita is explained by differences in GDP per worker between Latin American countries and the United States. As a summary measure, the ratio of GDP per hour between Latin America and the United States is 0.34 in 1960 and 0.24 in 2009, explaining 90 percent of the difference in GDP per capita in 1960 (log(0.34)/log(0.30)) and 97 percent in 2009 (log(0.24)/log(0.23)).

To summarize, GDP per capita between Latin America and the United States in 1960 is accounted for by:

$$\underbrace{\frac{(Y/P)_{LA}}{(Y/P)_{US}}}_{.30} = \underbrace{\frac{(Y/nE)_{LA}}{(Y/nE)_{US}}}_{.34} \times \underbrace{\frac{(E/P)_{LA}}{(E/P)_{US}}}_{.82} \times \underbrace{\frac{n_{LA}}{n_{US}}}_{1.07},$$

And relative GDP per capita in 2009:

$$\underbrace{\frac{(Y/P)_{LA}}{(Y/P)_{US}}}_{.23} = \underbrace{\frac{(Y/nE)_{LA}}{(Y/nE)_{US}}}_{.24} \times \underbrace{\frac{(E/P)_{LA}}{(E/P)_{US}}}_{.87} \times \underbrace{\frac{n_{LA}}{n_{US}}}_{1.11}.$$

Hence, low relative GDP per capita in Latin America: A labor productivity problem! Relative labor input ($E/P \times n$) changes from 0.88 in 1960 to 0.97 in 2009.

2.3 Decomposing GDP per Hour

To investigate the sources of differences in GDP per hour the standard procedure is to write down an aggregate production function that explicitly states the relevant factors of production. For this purpose, I consider a standard Cobb-Douglas aggregate production function augmented to include human capital,

$$Y = AK^{\alpha}H^{1-\alpha}, \tag{1}$$

where Y is output, K and H are the inputs of physical and human capital services, and A is total factor productivity (TFP). Since ultimately I am interested in broadly separating the importance of factor accumulation (human and physical capital) and TFP, I follow Bils and Klenow (2000) and Klenow and Rodriguez-Clare (1997) in writing the production function above in intensive form. To do this, first I write aggregate human capital (H) as the product of human capital per worker (h), the number of workers (E), and hours of work (n), i.e., $H = hEn$. Using this substitution in equation (1), dividing by Y on both sides, taking Y/nE to the left hand side, and rearranging terms I obtain:

$$\frac{Y}{nE} = A^{\frac{1}{1-\alpha}} \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} h. \tag{2}$$

Using equation (2), the ratio of GDP per hour (Y/nE) between countries i and j is given by:

$$\frac{(Y/nE)_i}{(Y/nE)_j} = \left(\frac{A_i}{A_j}\right)^{\frac{1}{1-\alpha}} \times \left(\frac{(K/Y)_i}{(K/Y)_j}\right)^{\frac{\alpha}{1-\alpha}} \times \frac{h_i}{h_j}. \tag{3}$$

In words, GDP per hour differences can be the result of three factors: differences in TFP, differences in physical capital to output, and differences in human capital per worker. The goal is to investigate the factors on the right hand side of equation (3) that can account for differences in GDP per hour of 1 to 4 between Latin America and the United States. Because measures of TFP are not readily available across countries, I follow the typical approach in developing accounting of measuring the factors of physical and human capital, leaving TFP as a residual. As is well known, this implies that mis-measurement of physical and human capital inputs will produce biased estimates of the implied differences in TFP. There is a large literature in development addressing the potential mis-measurement problems such as quality of physical and human capital, see for instance Klenow and Rodriguez-Clare (1997). Except for differences in human capital quality, which I will address explicitly below, the broad conclusion from this literature is that accounting for these measurement problems is unlikely to change the overall conclusion that differences in TFP are a critical determinant of income per capital differences across countries.

Physical Capital I first investigate the importance of physical capital accumulation. I focus on institutions and policies that lead to capital to output ratio differences across countries. Notice that differences in TFP could also cause capital accumulation to differ across countries. But in a broad class of models, TFP differences imply no differences in the capital to output ratio. This implication is what leads to the decomposition in equation (2) to be useful in separating the forces directly related to capital accumulation from TFP differences. So the next step is to look for measures of physical capital across countries. Typically the physical capital stock is measured in domestic prices. Cole et al. (2005) and others have used this measure from Nehru and Dhareshwar (1993) in their analysis. In these units the physical capital stock relative to GDP is not systematically different across Latin American countries and the United States. However, measuring the capital stock at domestic prices may give a biased view of capital accumulation since the price of capital goods is systematically higher in poor relative to rich countries (see for instance Restuccia and Urrutia, 2001). Alternatively, a measure of the capital stock at common international prices can be constructed using investment rates from the Penn World Table. I follow this approach in constructing the capital to output ratio for Latin American countries and the United States (see the Appendix for details). I report these estimates in Table 3. The main conclusion I draw is that capital accumulation as measured by the capital to output ratio is not systematically different between Latin America and the United States. In fact, in 1960 the capital to output ratio in Latin America was 13 percent above the level in the United States, whereas in 2009 the capital to output ratio was 31 percent below the level in the United States (see Table 4). Nevertheless, these level differences are too small to account for any substantial portion of the difference in labor productivity across these countries. For instance, with a capital share of 1/3 ($\alpha = 1/3$ in equation (3), a 13 percent higher capital to output ratio translates into a 6 percent higher GDP per hour and a 31 percent lower capital to output ratio translates into a 17 percent lower labor productivity. I conclude that although there are some relevant country differences in the capital to output ratio, these differences are not systematic and quantitatively substantial to explain differences in GDP per hour of a factor of 4 between Latin American countries and the United States.

Table 3: Real Physical Capital to GDP Ratio

	K/Y	
Country	1960	2009
Argentina	1.77	1.81
Bolivia	1.15	1.09
Brazil	1.85	1.50
Chile	3.17	2.31
Colombia	1.62	1.43
Ecuador	3.10	2.21
Mexico	2.23	2.43
Peru	4.41	2.02
Uruguay	2.08	1.53
Venezuela	3.61	1.74
Latin America	2.32	1.76
USA	2.05	2.57

Table 4: Real Physical Capital to Output Differences

	1960	2009
$(K/Y)_{LA}$	2.32	1.76
$(K/Y)_{US}$	2.05	2.57
Ratio	1.13	0.69
$\left(\frac{(K/Y)_{LA}}{(K/Y)_{US}}\right)^{\frac{\alpha}{1-\alpha}}$	1.06	0.83

Human Capital A serious limitation of development accounting studies lies in the difficulty in measuring human capital across countries. The most widely-available evidence is on the quantity of schooling across countries. Barro and Lee (2010) have collected detailed data on enrolment rates across different levels of education to calculate average years of schooling across a large set of countries. Using these data, Figure 4 reports the evolution of average years of schooling for Latin American countries and the United States. Average years of schooling is increasing in all countries. However, the data indicates important differences in education quantity across countries. For instance, average years of schooling in Latin America (geometric average) is 2.9 years in 1960 and 4.4 years in 2005 whereas for the United States is 8.5 years in 1960 and 10.9 years in 2010. From the accounting perspective the key issue is determining how years of schooling differences translate into human capital differences across countries. This is a difficult issue. The most widely-used approach, advocated by Bils and Klenow (2000) and implemented in a development accounting exercise by Klenow and Rodríguez-Clare (1997), is to use the insights from Mincer (1974) as to how years of schooling translate into human capital and hence wage-earnings differences across workers in an economy. The approach maps years of schooling into log wages using Mincer returns to schooling. Abstracting from age and experience differences the approach implies that human capital is given by $h = c_m \exp(\eta s)$ for workers in the same labor market, where c_m is a constant level parameter and η is the Mincer return to schooling, which is also assumed to be constant. Using this approach to estimate h_{LA}/h_{US} in equation (3) with $\eta = .1$, I find that this term is .57 in 1960 and .52 in 2010. This implies that measured TFP differences are the most important factor in explaining the low income per capita in Latin American economies. While this method of estimating human capital differences across countries is practical and well grounded on microeconomic evidence, it is now well-known that it has its limitations in measuring human capital differences across counties. While it may be reasonable to assume that c_m and γ are constant for workers in the same labor market, as this was the focus in Mincer (1974), it is less so for workers in different labor markets. The key issue is that the empirical specification cannot account for differences in the quality of education across countries. Those differences can be important.[4] More importantly, unlike the separation of TFP and physical capital accumulation implied by Solow-type growth models, it is generally difficult to disentangle the role of TFP and other factors in explaining schooling and human capital differences. For these reasons, recent studies have used quantitative theory to get at the importance of human capital in development – see for instance Manuelli and

[4] See for instance the papers by Hendricks (2002) and Schoellman (2012) assessing the role of quality differences for human capital across countries.

Seshadri (2006) and Erosa, Koreshkova, and Restuccia (2010).[5] How do productivity differences translate into human capital differences across countries? Standard models of human capital accumulation imply a log linear relationship between human capital and income when economies differ on TFP, i.e.,

$$\log h = c_h + \gamma \log(y),$$

where h is human capital per worker, y is labor productivity, and c_h is a constant. Substituting this expression for h in equation (2), GDP per hour (Y/nE) can be expressed as a function of TFP and capital accumulation, as follows:

$$\frac{Y}{nE} = c_y A^{\frac{1}{(1-\alpha)(1-\gamma)}} \left(\frac{K}{Y}\right)^{\frac{\alpha}{(1-\alpha)(1-\gamma)}}, \tag{4}$$

where c_y is a constant. Using equation (4), GDP per hour between countries i and j is given by:

$$\frac{(Y/nE)_i}{(Y/nE)_j} = \left(\frac{A_i}{A_j}\right)^{\frac{1}{(1-\alpha)(1-\gamma)}} \times \left(\frac{(K/Y)_i}{(K/Y)_j}\right)^{\frac{\alpha}{(1-\alpha)(1-\gamma)}}. \tag{5}$$

Note that the critical difference with equation (3) is the elasticity of the TFP and capital accumulation factors. Differences in TFP across countries lead to differences in physical capital accumulation and human capital accumulation (both in the form of quantity of schooling and on the quality of schooling). These factors can lead to a substantial amplification of TFP differences across countries. To see how important this mechanism can be, first suppose in equation (5) that $\gamma = 0$ and $\alpha = 1/3$ consistent with the standard one-sector growth model. Then in order to generate a factor of 4 difference in labor productivity between the United States and Latin America, a TFP ratio of 2.5 is needed – TFP in Latin America would need to be 0.4 that of the United States. This number is perhaps too small to be justified empirically. But if instead $\gamma = 1/2$, equation (5) would require a TFP ratio of 1.6 in order to achieve a factor of 4 difference in labor productivity. The key question is then how

[5] See also Restuccia and Vandenbroucke (2012) for an analysis of how development may explain the observed differences in education across countries at a point in time as well as over time.

important this amplification mechanism is quantitatively. Or to put it differently, what is a reasonable value for the elasticity parameter summarized by γ? I address this issue next. However, before I move on let me emphasize that the implicit assumption in equation 5 is that γ and c_y are constant across countries. I first note that this assumption is less restrictive than the related assumptions in the Mincer approach of c_m and η being constant. The reason is that γ is an elasticity whereas η is a semi-elasticity that in turns depends on average years of schooling. Put differently, Mincer returns to schooling η would tend to be high in countries with low average years of schooling. Similarly, while c_m may vary across countries due to country differences in educational quality, these factors are taken into account when estimating human capital and hence embedded in the estimates of γ. Nevertheless, while I think this is a simple and tractable approach in measuring human capital that takes into account key factors such as education quantity and quality, like in any abstraction, there are factors left behind that may lead to c_y and γ differences and hence the implied A differences may be biased by those factors, specially when considering country-specific experiences.

Total Factor Productivity The relationship implied by equation (5) can be used to establish the difference in TFP between Latin America and the United States that is needed in order to explain a difference in GDP per worker of 1 to 4. Using cross-section heterogeneity across people in the United States, Erosa, et al. (2010) estimate that γ is around 0.46.[6] Given this estimated value for γ, equation (5) implies that in order to generate a factor of 4 differences in GDP per worker between the United States and Latin America, TFP must be 60 percent higher in the United States. In the next section I consider a model of TFP that can potentially explain a productivity difference of this magnitude between Latin America and the United States.

[6]Roughly speaking, the parameters of the human capital production function that generate an elasticity of TFP on income across countries also generate an elasticity of heterogeneity across people and their earnings. So cross-section heterogeneity within a country gives some information on the relevant cross-country elasticity.

To summarize, relative GDP per hour in 1960 is accounted for by:

$$\underbrace{\frac{(Y/nE)_{LA}}{(Y/nE)_{US}}}_{.30} = \underbrace{\left(\frac{A_{LA}}{A_{US}}\right)^{\frac{1}{(1-\alpha)(1-\gamma)}}}_{.27} \times \underbrace{\left(\frac{(K/Y)_{LA}}{(K/Y)_{US}}\right)^{\frac{\alpha}{(1-\alpha)(1-\gamma)}}}_{1.12}.$$

And relative GDP per hour in 2009:

$$\underbrace{\frac{(Y/nE)_{LA}}{(Y/nE)_{US}}}_{.23} = \underbrace{\left(\frac{A_{LA}}{A_{US}}\right)^{\frac{1}{(1-\alpha)(1-\gamma)}}}_{.32} \times \underbrace{\left(\frac{(K/Y)_{LA}}{(K/Y)_{US}}\right)^{\frac{\alpha}{(1-\alpha)(1-\gamma)}}}_{.71}.$$

The TFP gap (A_{LA}/A_{US}) is 0.62 in 1960 and 0.66 in 2009. As a result, in both periods, low relative GDP per hour in Latin America is driven mainly by low relative TFP. While the decline in capital accumulation in Latin America explains most of the decline in relative GDP per hour between 1960 and 2009, this relative decline of 7 percentage points during the period is small compared to the large level gap in GDP per hour between Latin America and the United States. As a result, in what follows I focus on TFP as the main determinant of GDP per hour differences between Latin America and the United States.

2.4 Sectoral Labor Productivity

Before I move on to the model, one last point about the data. An argument could be made about Latin America suffering low productivity in specific sectors or distorting activity that affects some sectors of the economy more than others. This view of the development problem in Latin America is not consistent with the facts. I summarize the evidence from Duarte and Restuccia (2010) in Table 5.[7] The table reports labor productivity (real value added per labor hour) in each broad sector –agriculture, industry, and services– relative to that of the United States. The main finding is that low labor productivity in Latin America is a

[7] Duarte and Restuccia (2010) develop a tractable model of the structural transformation across agriculture, industry, and services to both measure sectoral productivity differences across countries and assess the importance of the structural transformation in aggregate productivity growth outcomes.

prevalent feature in all the sectors of the economy. I conclude that low labor productivity in Latin America is not the result of sector specific policies or distortions, instead it is an economy-wide phenomenon.

Table 5: Sectoral Labor Productivity (% relative to US)

	Agriculture		Industry		Services	
Countries	1960	2000	1960	2000	1960	2000
Argentina	42.1	27.3	65.7	66.5	62.2	34.4
Bolivia	12.7	4.4	62.9	13.4	24.2	6.2
Brasil	17.3	15.1	44.1	33.6	18.5	17.5
Chile	28.5	43.2	44.7	49.3	35.1	29.7
Colombia	17.7	7.3	54.3	29.7	22.1	11.8
Mexico	17.8	8.3	103.1	73.2	46.1	24.9
Peru	19.0	5.0	76.5	39.9	32.2	10.3
Venezuela	30.0	17.0	163.6	29.8	87.4	37.7
Latin America	21.6	11.9	69.9	37.4	32.8	16.7

All countries go through a process of structural transformation whereby the agricultural sector is replaced in importance by the industrial sector and later by the service sector. While labor productivity improvements in agriculture and specially industry have proven essential in explaining episodes of substantial catch-up in aggregate productivity between new industrialized countries and the United States such as Korea, Japan, Singapore, and many European countries, sectoral labor productivity in Latin America has failed to catch up in all sectors. While these facts underscore the importance of sector specific distortions or frictions, the analysis in Duarte and Restuccia (2010) indicate that productivity growth in the service sector may be the best avenue for Latin America to mount a substantial catch up in income to the technological leader.

3 A Model of TFP

There is a growing consensus in the recent macroeconomics literature that reallocation across micro productive units can have an important effect on aggregate productivity, where micro units can refer to sectors or establishments within sectors.[8] Since the evidence across sectors discussed earlier points to a productivity problem within each sector, in what follows I focus on reallocation across productive establishments without emphasis on the sectoral structure. I present an extension of a model of measured total factor productivity developed by Restuccia and Rogerson (2008). The theory builds from the industry equilibrium framework of Hopenhayn (1992) embedded into a standard neoclassical growth model. The basic ingredient of the theory is the heterogeneity in total factor productivity across establishments. In the context of this model, the allocation of factors of production across establishments leads to a role of policy distortions on aggregate measured TFP differences across countries. I now go onto the details of the model.

3.1 Economic Environment

There is an infinitely-lived representative household with preferences over streams of consumption goods at each date described by the utility function,

$$\sum_{t=0}^{\infty} \beta^t u(C_t),$$

where C_t is consumption at date t and $0 < \beta < 1$ is the discount factor. Households are endowed with one unit of productive time in each period and $K_0 > 0$ units of the capital stock at date 0.

Differently than in the standard neoclassical growth model, the unit of production is the

[8]See for instance Restuccia (2011) for a survey of this literature.

establishment. Each establishment is described by a decreasing returns-to-scale production function

$$f(s,k,n) = sk^{\alpha}n^{\gamma}, \qquad \alpha,\gamma \in (0,1), \quad 0 < \gamma + \alpha < 1.$$

with capital services k and labor services n as factor inputs. The technology parameter s varies across establishments. I assume that s can take on a discrete and finite number of values, $s \in S \equiv \{s_1, ..., s_{ns}\}$. As in Restuccia and Rogerson (2008), I abstract from variation in s over time. All establishments face an exogenous and constant probability of death λ. Exogenous exit realizations are *iid* across establishments and across time.

New establishments pay a set-up cost of c_e measured in terms of output. After paying this cost a realization of the establishment-level productivity parameter s is drawn but plants can invest in the likelihood of higher realizations of productivity levels. In particular, incurring the cost $c(q)$ in units of output, with probability q productivity is drawn from the higher productivity set $S_H \equiv \{s_{n_{\hat{s}}+1}, ..., s_{n_s}\}$ according to a *pdf* $h_H(s)$, while with probability $1-q$ productivity is drawn from the lower set $S_L \equiv \{s_1, ..., s_{n_{\hat{s}}}\}$ according to *pdf* $h_L(s)$, where $n_{\hat{s}} \in \{1, ..., n_s\}$. Draws are *iid* across entrants and there is a continuum of potential entrants. I denote by N_t the mass of entry in period t. I parameterize the cost function as

$$c(q) = Bq^{\phi}, \qquad B, \phi > 0.$$

Feasibility in this model requires:

$$C_t + X_t + c_e N_t + c(q_t)N_t \leq Y_t,$$

where C_t is aggregate consumption, X_t is aggregate investment in physical capital, $c(q_t)$ is the investment cost in establishment quality, N_t is aggregate entry, and Y_t is aggregate output. As in the standard neoclassical growth model, the aggregate law of motion for capital is given by:

$$K_{t+1} = (1 - \delta)K_t + X_t.$$

I focus on institutions and policies that create idiosyncratic distortions to establishment-level decisions as emphasized in Restuccia and Rogerson (2008). The empirical counterpart of these policies will be discussed in detail later. Broadly speaking these policies will be represented by a tax on output of operating plants τ. As in Restuccia and Rogerson (2008), I assume that τ can take on three values: a positive value reflecting that an establishment is being taxed, a negative value reflecting that the establishment is being subsidized, and zero reflecting no distortion for the establishment. Different specifications of policy are denoted by $\mathcal{P}(s, \tau)$ representing the probability that an establishment with productivity s faces policy τ and it is possible that the value of the establishment-level tax rate be correlated with the draw of the establishment-level productivity parameter. From the point of view of the establishment what matters is the joint probability distribution over s and τ and I denote this by $g_H(s, \tau)$ and $g_L(s, \tau)$ for productivity in the high and low sets. Not all policy configurations will lead to a balanced budget for the government so I assume that the government imposes a lump-sum tax (or transfer) T to consumers in order to balance the budget. I note that while I am modelling distortions as particular configurations of taxes/subsidies, I don't mean this literally. The types of policies and institutions that effectively act as idiosyncratic taxes/subsidies is very large and may include policies and institutions that on paper apply to all firms but effectively act as a tax on high productivity establishments. Enforcement differences, informality, and in general the endogenous reaction of firms decisions can create a pattern of distortions that effectively burden high productive enterprises. I will come back to this issue in the discussion of the results.

3.2 Equilibrium

The analysis focuses exclusively on the steady-state competitive equilibrium of the model. In a steady-state equilibrium the rental prices for labor and capital services are constant as well as all aggregates in the economy including the invariant distribution of establishments in the economy. The consumer's side of the model is entirely standard so I will skip the details. The important aspect to keep in mind from the consumer's problem is that the real interest rate in the economy is pinned down by preference parameters and the depreciation rate of the capital stock, i.e., in steady state the real interest rate, denoted by R, is given by

$$R = r - \delta = \frac{1}{\beta} - 1.$$

Incumbent Establishments The decision problem of an establishment to hire capital and labor services is static. The per-period profit function $\pi(s, \tau)$ satisfies:

$$\pi(s, \tau) = \max_{n,k \geq 0} \left\{ (1 - \tau) s k^{\alpha} n^{\gamma} - wn - rk \right\}.$$

It is simple to derive the optimal factor demands from this problem which I denote $\bar{k}$ and $\bar{n}$. Because both the establishment-level productivity and tax rate are constant over time, the discounted present value of an incumbent establishment is given by,

$$W(s, \tau) = \frac{\pi(s, \tau)}{1 - \rho},$$

where $\rho = \frac{1-\lambda}{1+R}$ is the discount rate for the plant, R is the (steady-state) real interest rate, and λ is the exogenous exit rate.

Entering Establishments Conditional upon entering, an establishment invests $c(q)$ in productivity. This investment leads to a probability q of drawing productivity from the set

S_H. I denote the optimal investment decision by $\bar{q}$. Potential entering establishments make their entry decision knowing that they face a distribution over potential draws for the pair (s,τ). The expected value of entering establishments is given by,

$$W_e = \max_q \left\{ q \sum_{\tau, s \in S_H} W(s,\tau) g_H(s,\tau) + (1-q) \sum_{\tau, s \in S_L} W(s,\tau) g_L(s,\tau) - c(q) \right\} - c_e.$$

Whether a potential entering establishment decides to enter or not depends on the expected value of entering W_e being greater than zero. In an equilibrium with entry, W_e must be equal to zero since otherwise additional establishments would enter. This condition is typically referred to as the free-entry condition.

Definition of Equilibrium A *steady-state competitive equilibrium* with entry is a wage rate w, a rental rate r, a lump-sum tax T, an aggregate distribution of establishments $\mu(s,\tau)$, a mass of entry N, value functions $W(s,\tau)$, $\pi(s,\tau)$, W_e, policy functions $\bar{k}(s,\tau)$, $\bar{n}(s,\tau)$, $\bar{q}$ for individual establishments, and aggregate levels of consumption (C) and capital (K) such that:

(i) (Consumer optimization) $r = 1/\beta - (1-\delta)$,

(ii) (Establishment optimization) Given prices (w,r), the functions π, W, and W_e solve incumbent and entering establishment's problems and $\bar{k}$, $\bar{n}$, $\bar{q}$ are optimal policy functions,

(iii) (Free-entry) $W_e = 0$,

(iv) (Market clearing)

$$\begin{aligned} 1 &= \sum_{s,\tau} \bar{n}(s,\tau)\mu(s,\tau), \\ K &= \sum_{s,\tau} \bar{k}(s,\tau)\mu(s,\tau), \\ C + \delta K + c_e N + c(\bar{q})N &= \sum_{s,\tau} f(s,\bar{k},\bar{n})\mu(s,\tau), \end{aligned}$$

(v) (Government budget balance)

$$T + \sum_{s,\tau} \tau f(s, \bar{k}, \bar{n}) \mu(s, \tau) = 0,$$

(vi) (μ is an invariant distribution)

$$\mu(s,\tau) = \begin{cases} \frac{N}{\lambda} \bar{q} g_H(s,\tau), & \forall s \in S_H, \forall \tau, \\ \frac{N}{\lambda} (1 - \bar{q}) g_L(s,\tau), & \forall s \in S_L, \forall \tau. \end{cases}$$

3.3 Calibration

I calibrate the model to data for the United States assuming that this is an economy with no distortions. The general strategy follows Cooley and Prescott (1995) in calibrating the neoclassical growth model. A period in the model corresponds to one year in the data. The discount factor is selected to match a real rate of return of 4 percent, implying $\beta = 0.96$. The parameter controlling decreasing returns to scale at the establishment is quantitatively important. I assume $\alpha + \gamma = 0.85$. Recent related studies have argued for values around this level, in particular, Atkeson and Kehoe (2005) using manufacturing data. But others using different calibration procedures and empirical strategies have arrived to similar values (see for instance Veracierto, 2001; Basu and Fernald, 1997; and Atkeson, Khan, and Ohanian, 1996). For more discussion on the implications of this choice see Restuccia and Rogerson (2008). Given this value, I separate α and γ according to the income share of capital and labor (1/3 and 2/3), hence $\alpha = 0.28$ and $\gamma = 0.57$. The depreciation rate of capital δ is chosen so that the capital to output ratio is equal to 2, implying $\delta = 0.10$. The exit rate λ is assumed to be 10 percent consistent with the evidence of job destruction rates in Davis, Haltiwanger, and Schuh (1996) and exit rates of plants in Tybout (2000).

In the economy with no distortions there is a simple mapping between establishment-level productivity and employment. So I choose the range of productivity to match the range of employment levels in the data. With the lowest establishment productivity normalized to one, this calibration implies that the highest productivity is 3.78. I use a log-spaced grid of establishment productivity with 100 points, i.e., $n_s = 100$. The next step is to restrict the probability distributions. I choose $n_{\hat{s}}$ to be 20 percent of n_s. With the calibrated distributions this implies that establishments in the set S_L represent close to 40 percent of all establishments. The mapping of productivity to employment implies that I can choose values of $[qh_H(s), (1-q)h_L(s)]$ to match the distribution of plants across employment sizes. This puts a restriction on the values of q and $h_H(s)$ and $h_L(s)$. For the cost function $c(q)$, I set $\phi = 2$ and then choose B so that the equilibrium $\bar{q} = 0.615$ which is the value implied by the U.S. establishment data. I use statistics from the U.S. Census Bureau (2007) to restrict these distribution. An important property of the U.S. establishment data is that there is a large number of establishments with a small number of workers and therefore these establishments account for a small share of the employment in the economy. About 50 percent of the establishments have less than 10 workers and these account for only 4 percent of the employment, while only half of a percent of establishments have more than 2,500 workers and represent 30 percent of the employment. Table 6 reports these statistics from the data and the calibrated economy. As the table shows, the calibrated economy matches the distribution statistics very well. Table 7 summarizes the parameter values and targets for the calibrated economy.

4 Quantitative Analysis

I study three types of experiments in the model to illustrate the potential quantitative role of reallocation across productive units in explaining low productivity in Latin America. First, I consider a modification of the benchmark economy to allow for a higher cost of entry. A well-known feature of Latin American economies is their higher cost of doing business. I will

Table 6: Distribution of Plants and Employment

	Share of (%)			
	Establishments		Employment	
Workers	Data	Model	Data	Model
Less than 10	51.4	51.4	4.0	3.8
Between 10 and 50	31.2	31.2	15.2	13.6
Between 50 and 500	16.0	16.0	48.3	43.8
More than 500	1.4	1.4	32.5	38.8

Table 7: Calibration

Parameter	Value	Target
α	0.28	Capital income share
γ	0.57	Labor income share
β	0.96	Real rate of return
δ	0.10	Capital to output ratio
c_e	1.0	Normalization
λ	0.1	Annual exit rate
$\{s_1, ..., s_{n_s}\}$, $h_H(s)$, $h_L(s)$	see text	Size distribution of plants
$n_{\hat{s}}$	20	–
ϕ	2	Baseline
B	2.4	$q = 0.615$

discuss this evidence in detail below. Second, I consider policies that distort the prices faced by different producers, what Restuccia and Rogerson (2008) call idiosyncratic distortions. I focus on policies that reallocate resources from high productivity to low productivity producers. There is evidence on the prevalence of this sort of misallocation in Latin America. I will discuss this evidence as well. Third, I evaluate the quantitative impact of the two previous experiments combined – higher entry costs and policy distortions. Table 8 summarizes the results of these experiments where all statistics (except q) are reported relative to the benchmark economy.

4.1 Entry Costs

I implement higher entry costs in the model as a higher cost of productivity draws from the upper end of the productivity distribution, i.e., a higher B. According to the Doing Business data of the World Bank, entry costs in developed countries are about 5 percent of GDP per capita whereas in Latin America entry costs are about 30 percent. There is wide dispersion in these costs across Latin American countries, with Chile featuring the lowest costs in the region and Bolivia among the highest. There are important limitations in the measures of entry costs and even more difficult is the exact mapping to the model. Rather than making an exact assessment of the quantitative importance of entry costs on productivity, my objective with this experiment is to illustrate the direction and magnitude of the potential effects. More comprehensive and elaborate assessments of entry costs on productivity across countries are found in the recent literature, see for instance Poschke (2010), Barseghyan and DiCecio (2011), and Moscoso-Boedo and Mukoyama (2011). In the experiment, I assume a 50 percent higher B than in the benchmark economy. Higher entry costs discourage establishments entering the market, see column (2) in Table 8. This reduces productivity compared to the benchmark economy because establishment sizes are distorted. With the higher entry cost the average establishment has more workers than in the benchmark economy. The aggregate productivity effect of the higher entry cost is not large, it reduces output per worker in about 5 percent compared to the benchmark economy. The higher entry cost reduces q to 50 percent (vs 62 percent in the baseline) so there is not only misallocation through larger establishments, but also there is a shift in the distribution of establishments towards the lower productivity ones.[9]

[9]Similar aggregate productivity results are obtained if instead higher entry costs are implemented as a higher c_e. The main difference is that entry is much more responsive to variation in c_e and q may increase as a result.

Table 8: Quantitative Experiments

Variable	Benchmark Economy	Experiments (1) Entry Cost	(2) Policy Distortions	(3) Entry-Policy Distortions
Relative Y	1.00	0.95	0.69	0.66
Relative TFP	1.00	0.96	0.69	0.66
Relative E	1.00	0.96	1.85	1.87
Relative w	1.00	0.95	1.00	1.00
q	0.62	0.50	0.11	0.07

Notes: (1) Entry Cost refers to an increase in B of 50 percent relative to the benchmark economy. (2) Policy Distortions refers to idiosyncratic output taxes of 10 percent to the 50 percent most productive establishments. (3) Both entry costs and policy distortions.

4.2 Idiosyncratic Distortions

In the next experiment, I implement a set of policies that create differences in the output prices of heterogeneous producers. Restuccia and Rogerson (2008) study a general configuration of these policies. More recently, Hsieh and Klenow (2009) for China and India and Pages (2010) for Latin American countries, have shown that output wedges across establishments are a prevalent feature of the data for developing countries. Many policies effectively takes this form. Taxes and regulations are applied and enforced on larger, presumably more productive, establishments. Informality may be the optimal response of low productivity entrepreneurs to high taxes and regulations. Public enterprises are often large establishments with low productivity that are propped up by subsidies to output or inputs and these subsidies are financed by taxes on other activities thought government budgets. Credit frictions translate into higher cost of capital for high productive entrepreneurs. Industrial policies in poor countries tend to promote some activities in detriment of others often guided by non-economic factors. To illustrate the potential impact of these broad types of policies and institutions in poorer countries such as those in Latin America, I assume that the 50 percent most productive establishments are taxed while the rest are subsidized. I set the tax rate to 10 percent and then compute the subsidy rate that leaves capital accumulation the same. Holding capital accumulation constant is motivated by the observations discussed previously that capital accumulation is not a fundamental factor in explaining low relative labor productivity in Latin America. The effect on output is larger for this sort of policy, see Table 8 column (2). Output falls by more than 30 percent. This is mainly the result of a systematic distortion on establishments – productive plants become small because of the tax while unproductive plants become larger because of the subsidy. This distortion entails a misallocation of resources across plants with different productivity. In addition, the policy leads to decrease in investment in plant productivity so q falls to 11 percent vs. 62 percent in the benchmark economy. This shifts the distribution of plants by employment size to the left, reducing the average establishment size in more than 40 percent. This effect on the average establishment size is consistent with the evidence in Tybout (2000) and Pages (2010) that production in developing countries takes place in smaller units.

4.3 Entry Costs and Policy Distortions

In the last experiment, I consider both entry costs and policy distortions as described previously. When combined with higher entry costs, policy distortions create a fall in output and productivity of almost 40 percent, see Table 8 column (3). This is close to the magnitude in productivity that is needed to generate the observed difference in labor productivity between Latin America and the United States when capital accumulation is augmented to include human capital. As with the previous experiments, the drop in productivity is a result of misallocation and a shift in the distribution of establishments by productivity (q falls to 7 percent in this experiment vs 62 percent in the benchmark). To appreciate the magnitude of reallocation involved in this experiment, Table 9 reports distributional statistics. Note that establishments in the high productivity set are on average twice as productive as the establishments in the low productivity set, but whereas in the benchmark economy 38 percent of establishments are in the low set and only represent 1.9 percent of the employment (62 percent of establishments are in the high productivity set and represent 98.1 percent of the employment), in the distorted economy 93 percent of establishments are in the low productivity set and represent 89 percent of the employment (7 percent of the establishments are in the high productivity set and represent 10 percent of the employment). Hence, entry costs and policy distortions can potentially generate a substantial reduction in measured productivity by inducing substantial amounts of reallocation and a shift in the distribution of productivity.

Table 9: Distributional Statistics

	Productivity Set	
	Low S_L	High S_H
Average Productivity	1.1	2.3
Benchmark Economy:		
Fraction of Establishments (%)	38.5	61.5
Fraction of Employment (%)	1.9	98.1
Distorted Economy:		
Fraction of Establishments (%)	92.7	7.3
Fraction of Employment (%)	89.2	10.8

4.4 Discussion

While the policy experiments considered above are simplified and abstract, I argue they capture the essence of the empirical evidence on the cost of doing business in Latin America and the myriad of policies and institutions that distort firm size, in some cases effectively affecting disproportionally more large and productive establishments in Latin America. I briefly discuss some of this evidence.

There is abundant evidence on the high cost of doing business in Latin America. The most well-known empirical cases are De Soto (1986) and Djankov, La Porta, Lopez-de-Silanes, Shleifer (2002). For instance, according to the data on barriers to entry in Djankov et al. (2002), firms in Latin American countries have a cost of entry – a measure on the cost of entry (time and goods) as a proportion of GDP per capita – that ranges between 20 to 300 percent. This cost is less than 2 percent in developed economies. (See Table 10 for the cost of entry in Latin America from Djankov et al.) The work of Djankov et al. has been extended by the World Bank into what is now called Doing Business. The data rank a large number of countries in categories such as cost of starting a business, dealing with licences, protecting investors, enforcing contracts, trade and other restrictions. The data is reported every year (see World Bank, Doing Business Database, 2012).[10] Not surprisingly, Latin American economies rank among the economies with the highest costs of doing business, costs that are much higher than in developed countries such as Canada and the United States. Figure 5 reports the indicators of ease of doing business (rank), cost of starting a business (percent of GDP per capita), cost of getting electricity (percent of GDP per capita), and the cost of registering property (percent of property value). In all these measures, Latin American economies feature a more difficult environment for firms to start and operate. Broader measures of regulation and their effect on economic performance have been constructed and analyzed by Loayza, Oviedo, and Serven (2007). Again, these measures indicate that Latin America has an overly regulated economy, with many of these restrictions imposing not only high costs of operating a business but also many of these restrictions becoming a de-facto tax on large and productive firms.[11] The regulatory environment is often viewed as an important determinant of informality in Latin America. According to Perry, et al. (2007), 56 percent of the labor force is informal with the associated negative implications on the productivity of such activities. Leal (2010) has studied informality in Mexico using a framework with heterogeneous producers where regulations and taxes rationalize entry

[10] For other related measures on the cost of doing business in Latin America see also Fantoni (2007).

[11] For instance, Galindo, Schiantarelli, and Weiss (2007) document that in developing countries financial reforms affect the allocation of investment, leading to higher productivity.

into the informal sector. Leal finds that these regulations and taxes can account for the prevalence of informality in Mexico with large negative effects on aggregate productivity.

Table 10: Barriers to Entry in Latin America

Country	Cost
USA	2
Chile	24
Argentina, Colombia	≈ 35
Brazil	45
Peru, Uruguay, Venezuela	≈ 53
Mexico	83
Ecuador	91
Bolivia	300

Evidence on measures of idiosyncratic distortions is more sparse as the data requirements to construct such measures is enormous. Moreover, there is no silver bullet for specific distortions. Hsieh and Klenow (2009) have estimated large productivity losses associated with misallocation in China and India using a heterogenous-establishment framework and micro data on establishments in these countries. The distortions are estimated as reduced-form taxes and subsidies on output and capital that create dispersion in revenue productivity across establishments. Dispersion in revenue productivity is indicative of misallocation as the framework implies that in the absence of distortions establishments act to equalize the marginal products of the factors of production. For China and India, the productivity loss of misallocation (relative to that in the United States) is in the order of 20 to 60 percent. Moreover, Hsieh and Klenow find that the distribution of establishment productivity is more dispersed with a substantial shift in the distribution towards very small unproductive establishments. For Latin America, the evidence is even more striking. Pages (2010) summarizes a set of studies, following Hsieh and Klenow (2009), that estimate the productivity loss associated with misallocation using establishment-level data for Latin American economies. These studies uncover important distortions across firms in Latin America with substantial negative effects on measured productivity. For instance, the dispersion in revenue productivity as a summary measure of distortions is reported to be much larger in Latin America than in the United States. In fact, some countries have larger dispersion in revenue productivity than China or India (see Figure 6 from Bello et al., 2011 and Pages, 2010). Another indirect approach to assessing the empirical relevance of distortions in Latin America is to look at the distribution of establishments in these countries. In the United States, 55 percent of establishments are small (less than 10 workers) and these establishments account for only about 4 percent of employment. In contrast, in countries such as Bolivia, Argentina, and Mexico, more than 80 percent of establishments are small and account for 22 to 44 percent of employment (see Pages, 2010). This evidence is consistent with the distributional implications of the model with high entry costs and idiosyncratic distortions (see Table 9). Latin America also ranks low in the quality of property-rights institutions. Weak enforcement of property rights can lead to a form of extortion that would effectively act as idiosyncratic distortions. Ranasinghe (2011) has shown that weak property rights institutions can lead to substantial productivity losses associated with misallocation. Understanding the exact policies and institutions that generate such distortions and reallocation is a fundamental objective for future research.[12]

I have abstracted in my analysis from volatility in economic activity as a deterrent to growth and productivity. As alluded to in the introduction, there is substantial empirical evidence of a negative association between volatility and growth. While I have abstracted from volatility as a specific feature of the environment, high volatility can be a source of misallocation and recently several studies have connected specific crisis episodes with misallocation, see for instance the work by Oberfield (2013) for the Chilean crisis of 1982 and the references therein.

[12]There are many on-going research efforts providing measurement and quantitative assessment of specific policies and institutions, see for instance Restuccia and Rogerson (2013) for a summary of some of this research.

5 Conclusions

In this paper I make two main points. First, I showed that low GDP per capita in Latin America relative to the United States (what I call the development problem of Latin America) is due to low relative total factor productivity. In other words, the development problem of Latin America is a productivity problem. I calculate that in order to explain a factor of 1 to 4 difference in GDP per worker between Latin America and the United States only a 1 to 1.6 difference in TFP would be needed. The larger difference in labor productivity arises as an amplification of productivity through physical and human capital accumulation. Second, I considered a framework where institutions and policy distortions create a misallocation of factors across heterogeneous producers that can potentially explain the low relative productivity in Latin America. Barriers to formal market entry, regulation and barriers to competition, trade barriers and employment protection, and general policies that discriminate against productive establishments may be at the core of productivity differences between Latin America and the United States. Removing these barriers can lead to an increase in long-run labor productivity in Latin America relative to the United States of a factor of 4. This increase in income amounts to 70 years worth of U.S. post-WWII development.

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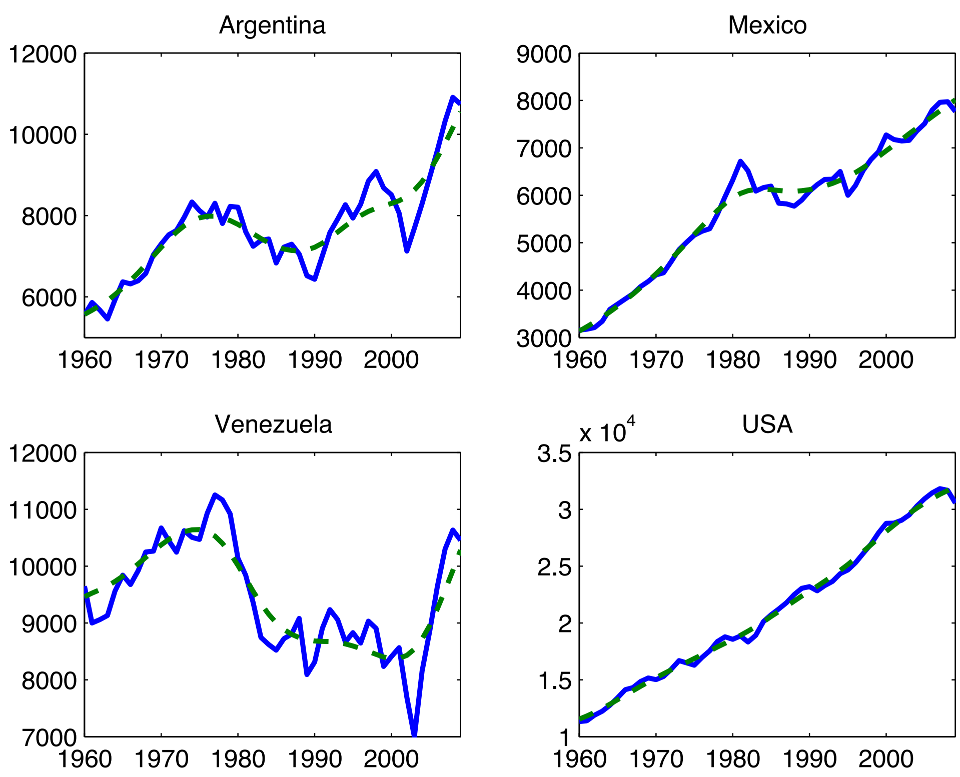
A Data Sources and Definitions

The data covers 10 Latin American countries. These are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and Venezuela. For most countries the time series include data from 1950 to 2009. The main source of data is the Conference Board and Groningen Growth Centre (2010).

I use data from Penn World Tables version 6.2. (see Heston, Summers, and Aten, 2002) to construct annual time series of PPP-adjusted investment to GDP ratio. This series cover the period 1950 to 2009 for all countries. I use the investment rates at international prices to obtain a measure of physical capital to output ratio (K/Y)at international prices. I proceed as follows: (1) Estimate K/Y in 1954 using the average I/Y from PWT 1950-54 and the steady-state relationship implied by a standard Solow model, i.e., $K/Y = \frac{I/Y}{(n+g+\delta+ng)}$ where n is the growth rate of population, g is the growth rate of productivity, and δ is the depreciation rate of capital. I assume $\delta_2 \equiv n + g + ng + \delta = 0.10$. (2) Use I/Y to compute K/Y over time using the standard capital accumulation equation $K_{t+1} = (1-\delta)K_t + I_t$. This implies, $\frac{K_{t+1}}{Y_{t+1}} = \hat{g}_t \times \left[(1-\delta)\frac{K_t}{Y_t} + \frac{I_t}{Y_t}\right]$ where $\hat{g}$ is the gross growth rate of output (growth in output per capita times population growth). The sectoral data is from Duarte and Restuccia (2010) for details see their appendix. Data on years of schooling is from Barro and Lee (2010).

All series are trended using the Hodrick-Prescott filter with a smoothing parameter $\lambda = 100$ before any ratios are computed.

Figure 1: GDP per Capita in Some Countries



The solid line represents real GDP per Capita from the Conference Board and Groningen Growth Centre (2010) and the dashed line the Hodrick-Prescott trend.

Figure 2: GDP per Capita relative to the United States

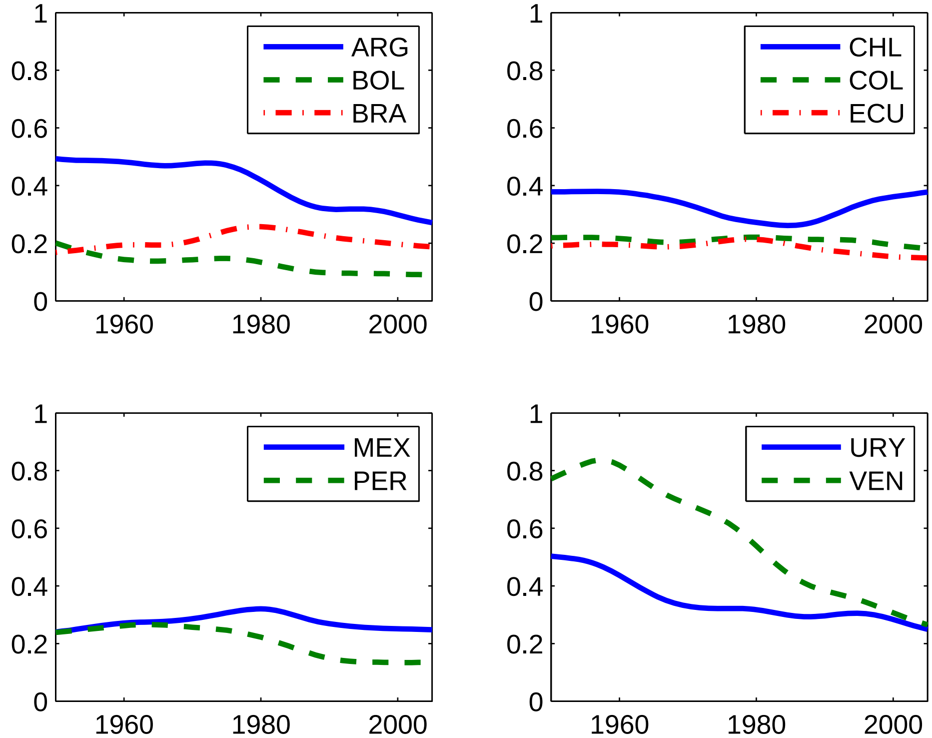


Figure 3: Annual Hours per Worker

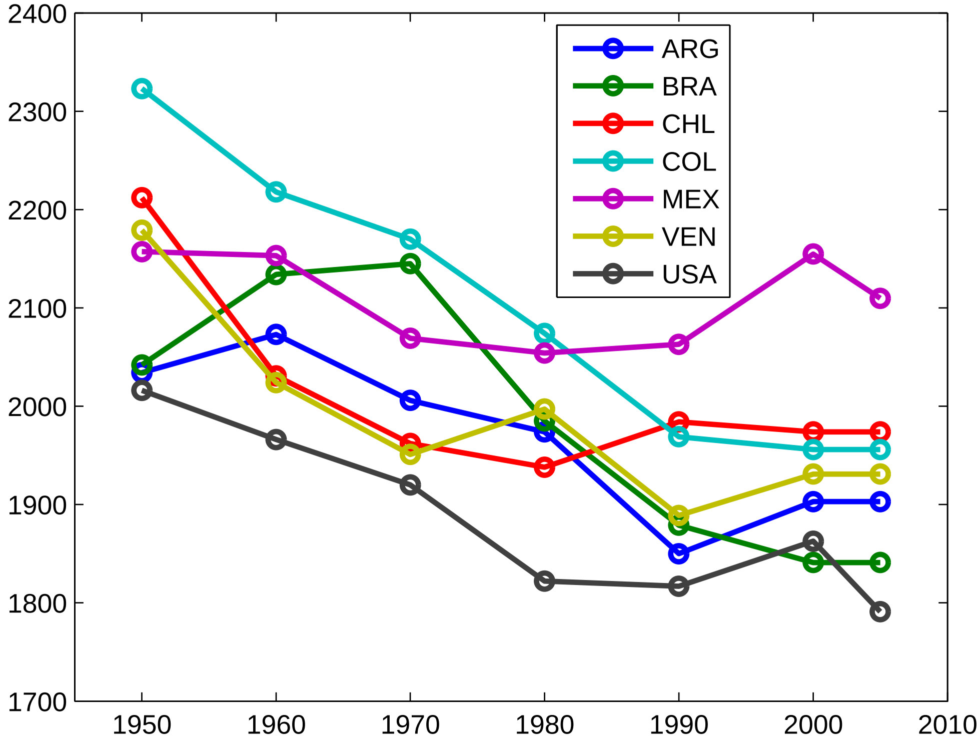


Figure 4: Average Years of Schooling

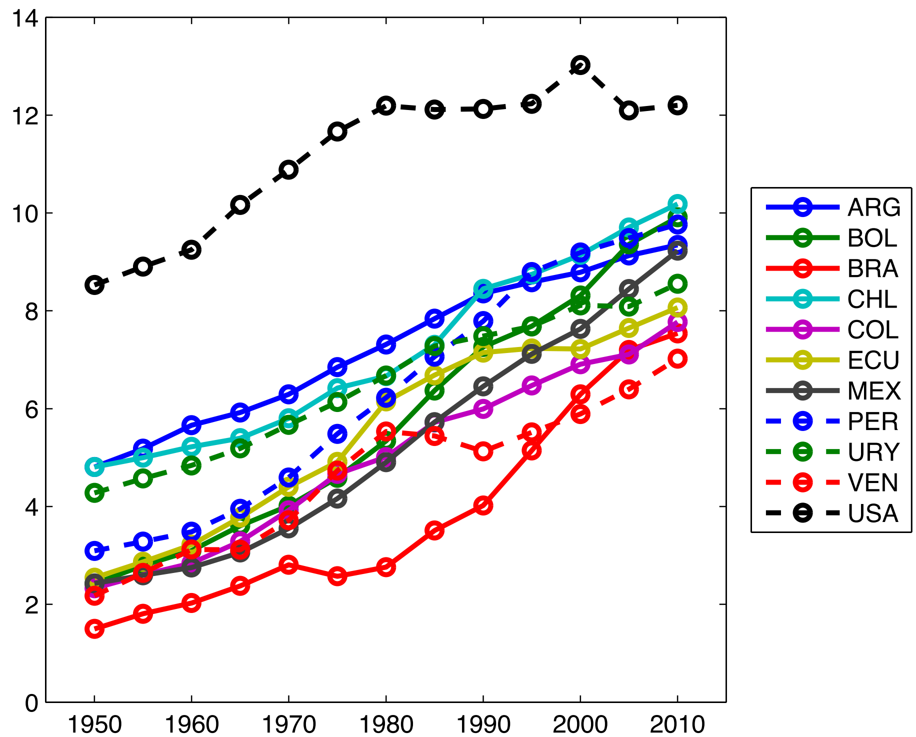


Figure 5: Doing Business in Latin America

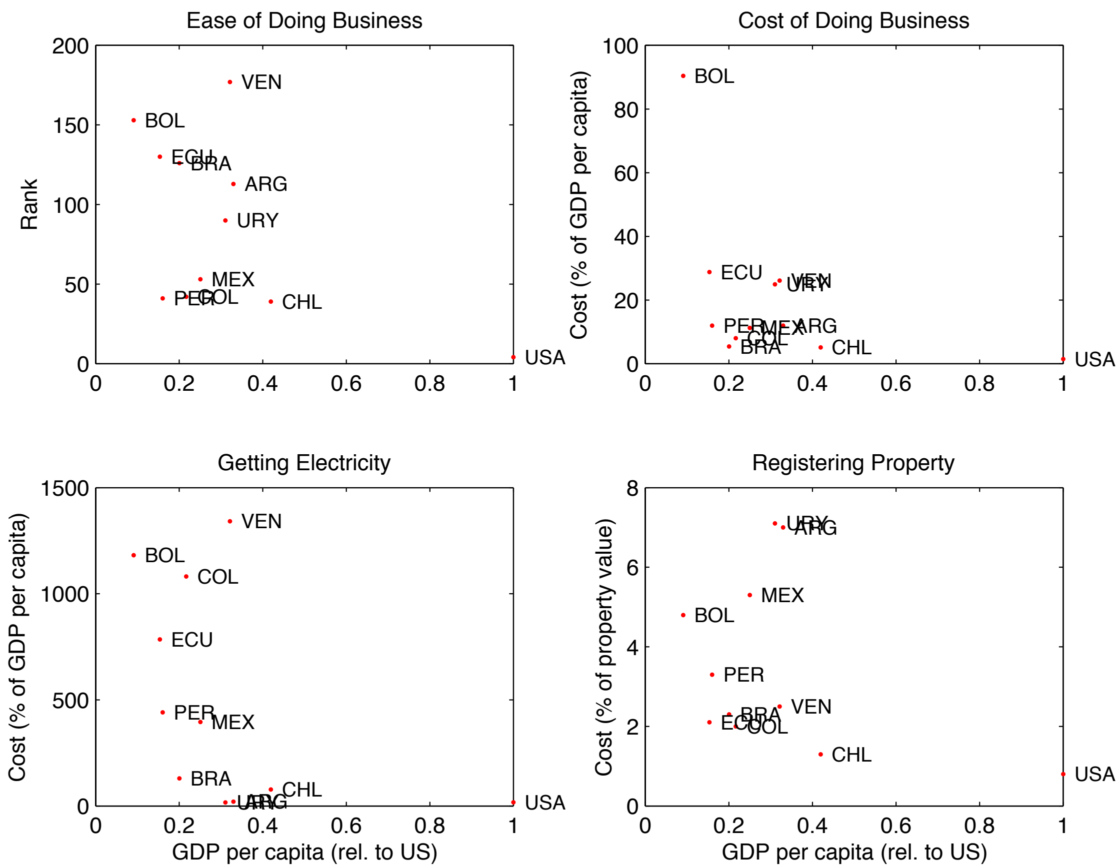


Figure 6: Dispersion in Establishment-Level Revenue Productivity