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THE GREAT LEAP FORWARD: THE POLITICAL ECONOMY OF EDUCATION IN BRAZIL, 1889-1930

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The Great Leap Forward: The Political Economy of Education in Brazil, 1889-1930

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Abstract

Brazil at the turn of the twentieth century offers an interesting puzzle. Among the large economies in the Americas it had the lowest level of literacy in 1890, but by 1940 the country had surpassed most of its peers in terms of literacy and had done a significant improvement of its education system. All of this happened in spite of the fact that the Constitution of 1891 included a literacy requirement to vote and gave states the responsibility to spend on education. That is to say, Brazilian states had a significant improvement in education levels and a significant increase in expenditures on education per capita despite having institutions that limited political participation for the masses (Lindert, 2004; Engerman, Mariscal and Sokoloff, 2009) and having one of the worst colonial institutional legacies of the Americas (Acemoglu, Johnson, and Robison, 2001; Easterly and Levine, 2003; and Engerman and Sokoloff, 1997, 2002). This paper explains how state governments got the funds to pay for education and examines the incentives that politicians had to spend on education between 1889 to 1930. Our findings are threefold. First, we show that the Constitution of 1891, which decentralized education and allowed states to collect export taxes to finance expenditures, rendered states with higher windfall tax revenues from the export of commodities to spend more on education per capita. Second, we prove that colonial institutions constrained the financing of education, but that nonetheless the net effect of the increase in commodity exports always led to a net increase in education expenditures. Finally, we argue that political competition after 1891 led politicians to spend on education, Since only literate adults could vote, we show that increases in expenditures (and increases in revenues from export taxes) led to increases in the number of voters at the state level.

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Introduction

In 1890, only 15% of the population of Brazil was literate. This placed Brazil as the country with the lowest literacy rate among the large economies in the Americas. This level of education, for example, looked dismal compared to literacy rates in Argentina, Chile, Colombia, Jamaica, or Uruguay, which circa 1890 had literacy rates between 30% and 50% (Engerman, Mariscal and Sokoloff, 2009; Engerman and Sokoloff, 2002). In fact, Brazil's literacy rate in 1890 was closer to that of Guatemala (11.3%) and Honduras (15.3%). Yet, between 1890 and 1940 Brazil had the most rapid increase in literacy rates in the Americas; the country caught up and even surpassed some of its more educated peers (e.g., Mexico, Colombia, and Venezuela) (see Table 1). This increase in literacy rates was also accompanied by a brisk increase in the number of public schools, enrollment rates, and the number of teachers. What makes this rapid expansion in the provision of public education more impressive is that it took place despite the fact that the Constitution of 1891 introduced a literacy requirement to vote. Why were political elites in Brazil willing to finance an expansion of public education for all? How did the federal and state governments pay for it?

Students of the American "human-capital century" argue that for such a leap forward to occur there have to be a set of values in place to promote education. Among those values or characteristics are public funding for education, openness, gender neutrality, state and/or local control of schools, separation of church and state, and an academic curriculum (Goldin, 2001). Moreover, Gallego (forthcoming) shows that more decentralization in education expenditures can led to higher levels of education in former colonies. We document a period in which education expenditures were decentralized in Brazil and politicians and political parties at the state level upheld most of those values. The result was a rapid increase in the provision of public education. Progress in elementary education across states, however, was asymmetric, with some states increasing expenditures per capita and obtaining higher literacy and enrollment rates relatively fast, while others lagged behind.

In this paper we explain the increase in education expenditures across the board and the variation in education expenditures and outcomes across states. We proceed in three steps. First, we document the rapid developments in education between 1889 and 1940. Second, we explain how increases in export tax revenues explain both the jump in education expenditures

and the variation in expenditures and outcomes across states. Finally, we explain the incentives that all political elites at the state level had to expand public education and to increase literacy rates and try to disentangle why some state politicians made education more of a priority.

The increase in expenditures in education per capita at the state level was not the result of a federal program, but happened because of an expansion in the provision of public education at the state level. The Constitution of 1891 allowed states to collect export taxes to finance expenditures, furthermore, it gave them the obligation to spend on public education. Because most states in Brazil were net exporters of commodities to the rest of the world, increases in commodity prices had an exogenous and asymmetric effect on the capacity that state governments had to spend on public goods. Using both OLS and IV techniques we find that price shocks had significant effects on state expenditures in education among Brazilian states (controlling for a series of state characteristics, fixed effects, and time dummies).

Yet, merely showing that states have more money to spend as a result of increased tax revenues does not explain why state politicians used it to improve public education. That is, the increase in revenues by state may be exogenous (according to changes in the international demand for commodities), but the initial distribution of education and the configuration of state institutions may not have been random. Therefore, we proceed in two ways to make sure we are controlling for initial conditions as much as possible. First, we try to do all of our econometric analysis controlling for fixed effects. In that way we focus on the changes in expenditures on education or on education outcomes over time in each state. Second, we examine initial conditions that may have led elites to spend more or less on education when exports tax revenues went up, such as the original distribution of political and economic power in a given state. We look at some of the variables that are now identified as proxies for "colonial institutions" and that are either proxies for the distribution of economic power (e.g., the % of slaves to total population, the concentration of land holdings, or dummies for whether the main commodity produced in a state relies on plantation agriculture or slave or coerced labor) or proxies for living conditions that may lead elites to install more extractive institutions, such as a high mortality rate or a high mortality rate due to tropical diseases. According to Acemoglu, Johnson, and Robinson (2001), across countries high mortality rates in the nineteenth century

are correlated with weaker rule of law today.[1] For simplicity, we call the set of all of these variables "colonial institutions," even if not all these initial conditions come from colonial times. This is because the argument of the literature is that inequality in the distribution of economic assets and political power was broadly determined during colonial times and then persisted over time.[2]

Our estimates show that an increase in commodity prices usually had a net positive effect on expenditures on education no matter what colonial institutions a state had. Colonial institutions, however, did hold back the expansion of education in some states (e.g., the coefficient for the interaction of colonial institutions and export tax revenue per capita are negative and significant but always lower than the coefficient for export tax revenues alone). [3]

We then proceed to examine three possible economic incentives that state politicians had to expand the provision of public education between 1889 and 1930. First, state politicians could have invested in education either to attract European immigrants or help immigrants adapt to local customs and culture, or because in places with more immigrants the demand for education was higher. Second, we think that another possibility is that parties and politicians at the state

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[1] A large literature would argue that these initial conditions in Brazil (and other countries in the Americas) led to adverse institutions in the long run. For crosscountry studies see, for instance, Acemoglu, Johnson, and Robison (2001), Easterly and Levine (2002), and Engerman and Sokoloff (1997, 2002). For studies that look at the variation within Brazil according to colonial institutions see, for example, Naritomi, Soares, and Assunção (2007) and Bruhn and Gallego (2007). Gallego (forthcoming), in contrast, argues that initial institutions matter in as much as they can determine how decentralized are the expenditures on education. He shows that decentralization of government expenditures and democracy measures are the most important determinants of education levels in former colonies and that colonizers chose the level of decentralization (and democracy) according to how many ethnic groups lived in the geographical area they colonized.

[2] We actually think that for some variables there is relative persistence. For instance, the correlation of the number of slaves by state in 1864, the first year for which we have data, and 1887 , the last year before emancipation, is 0.8, even though there was significant migration from the sugar regions in the northeast to the coffee areas of the southeast of Brazil. Yet, we are not sure about the persistence in land holding patterns, because as explained by Engerman and Sokoloff (forthcoming), land laws and land ownership had more changes over time than other institutions.

[3] In a sense our work follows the work of Mariscal and Sokolof (2000), Gallego (forthcoming), and Banerjee and Iyer (2005), who argue that colonial institutions mattered for the provision of education. Bajerjee and Iyer (2005) investigated how the variation in British colonial institutions among Indian regions explains significant differences in the provision of public goods, such as education. We show that institutions attenuated the positive effects of a trade boom, but were not necessarily holding back states in Brazil since the net effect of the trade shocks tend to be positive after subtracting the interaction with colonial institutions.

level spent on education to either attract new industries that required somewhat educated labor or as a response to pressures from established industrialists who needed skilled labor. Yet we are also conscious that because most of the manufacturing industries in Brazil did not have a strong skill-technology complementarity, industrialists may not necessarily have demanded skill labor and, on the contrary, they may have preferred to keep the population uneducated. Third, we think that electoral competition after the Constitution of 1891 provided incentives for states to spend on education, even though Brazil had a literacy requirement to vote sine 1882. In order to get more leverage vis-á-vis the dominant political parties at the national level, politicians at the state level needed more votes; in order to increase the number of voters in a state, politicians needed to increase the number of literate males.

The evidence we have does supports the first two hypotheses only weakly. For instance, we find strong correlations between the percentage of foreigners in a state and education expenditures, but not with the number of schools or the teacher pupil ratio. In terms of the relationship between industrialization and education at the state level, we find no significant evidence that they were correlated.

In contrast, we provide econometric evidence that exhibits a strong correlation between expenditures on education and an increase in the number of voters over time, something that we think goes more in line with the "electoral" hypothesis. In fact, when we use commodity prices at the state level as independent variable (as a proxy for export tax revenues) we also find a strong correlation with the number of voters. That means that states that had more revenues from taxing exports also could spend more on education and could increase the number of voters in the state. This finding is particularly important because Engerman, Mariscal and Sokoloff (2009) and Engerman and Sokoloff (2002) show that countries that had literacy requirements in the Americas tended to spend less on education and Lindert (2004) shows the same result for a larger cross-section of countries, including developed and developing countries in the nineteenth century. We, on the other hand, argue that the literacy requirement itself coupled with electoral competition provided incentives to increase expenditures on education.

Finally, we show that our findings for the period 1889 to 1940 have implications in the long run because the change in terms of trade that states in Brazil experienced between 1889 and 1930 altered the relative inequality in education outcomes in a permanent way. We show

how some states that had low levels of education in the 1870s ended up with relatively high levels of education after state governments spent more on education. Yet, other states that had relatively higher levels of education before 1890 and that did not spend too much on education during the period we study (either because its exports did not have a high price run up or because of its bad institutions) ended up at the bottom of the ranking of education indicators by 1930. This is important because the ranking of states in terms of literacy in 1930 and 2007 is very similar (the correlation is close to one and significant at 5%). Thus, we think that the trade shocks we document, interacted with initial conditions, had path-dependent effects in the twentieth century.

The paper is organized as follows. In Section II we present original data to document the rapid improvement in the supply of public education in Brazil between 1889 and 1930. Section III shows how commodity prices determined the changes in expenditures on education and in education indicators. Section IV discusses the incentives of political elites to spend on education. Section V discusses some of the long-term implications of education policy between 1889 and 1930. Section VI concludes.

The Evolution of Education in Brazil from Independence to 1930

Education Policy and Literacy Rates in Brazil in the Nineteenth Century

A newly independent Brazil adopted, in 1821, a constitutional monarchy with a clear division of power and centralized taxation. During the imperial period (1821-1889), executive power rested with the emperor and council of ministers and an elected parliament was responsible for legislative tasks. Parliamentarians (senators and deputies) were elected by state electoral colleges. Electoral participation was restricted by an income requirement, which was a year's income for most skilled professions.[4] Provincial governments were weak and had little

[4] The process was, in fact, even more complex because Brazil had a system of indirect elections. That is, voters in parishes (known as *eleitores*) would vote to elect an electoral college similar to that of the United States. The members of this electoral college were known as *votantes* (voters). The Constitution of 1824 included income requirements for both, eleitores and votantes. For the former it was 100$ per year (or approximately US $60), while the latter needed to prove an income of $200. There were exceptions to this requirement, mostly for members of the army. See Porto (2002), especially pp. 44-45. Law 3029 of January 9, 1881 increased the income requirement to vote to 200$ for eleitores.

control over fiscal revenues under this political arrangement, and most of the revenues collected by the central government were spent in the capital.

Despite the centralization of taxation and expenditures, the members of congress that drafted the Constitution of 1824 chose to decentralize the provision of education. Therefore, from 1824 on, the imperial government focused mostly on providing education in the capital of the country and the provincial governments were in charge of elementary and secondary education in their own territories. The central government subsidized some of the schools in the provinces, especially the law schools of Sao Paulo and Pernambuco, but most of the fiscal effort to pay for education fell on the provincial governments.

The centralization of fiscal resources paired with the decentralization of education yielded poor results. Circa 1878, Leôncio de Carvalho, Minster for Internal Affairs (Ministro de Estado e Negócios do Império), published a study that portrayed the poor state of public education in Brazil. He argued that the conditions for elementary education were "lamentable." Elementary schools were operating out of rented houses, "most of them poorly placed, lacking the minimum pedagogic and hygiene conditions." They were understaffed or staffed with teachers that received low salaries and did not have the minimum pedagogical training. The school system was not big enough to satisfy the needs of a population of seven million people. He calculated that of a total population of 1,902,454 school-age children (6 to 15 years old) in the early 1870s, only 321, 449 (17%) attended a school regularly. For all of these reasons de Carvalho concluded that the provinces could not provide adequate elementary education. They lacked the necessary resources as a consequence of the "fatal centralization" of the public finances (Moraes, 2006; p. 44).

Most schools during the first few decades of the nineteenth century relied on the Lancaster method of education. Schools tended to have one teacher in one large classroom in which students from the first grade were mixed with students from the second grade (elementary education was separated into two grades and students tended to spend two to three years per grade). The basic pedagogical approach behind this method was that older students would help younger students learn (Ghiraldelli, 2008, pp. 28-29).

In 1879, de Carvalho sent a bill to reform the education system of the country to Congress. In this bill, known as the Leoncio de Carvalho Reform, Congress ended mandatory

religious education, making it optional for Catholic children enrolled in public schools. Moreover, in this bill de Carvalho mandated the creation of Teaching Schools (*escolas normais,* hereafter referred to as Normal schools) in the provinces of the country.[5] From the statistical reports that Minister Carvalho prepared we know that there were five states without a Normal school, about seven states that only had one of such schools; the larger states had two each (Correia, 1878; p. 14). A report for the state congress of Sao Paulo in 1873 found that the exams teachers needed to pass in order to get a job were too easy, highlighted by the fact that no one ever failed them (Costa, 1983; p. 88).

Additionaly, the De Carvalho Reform outlined mandatory courses for the schools in the capital of the country, with some basic science in the more advanced courses. He explicitly ordered schools to teach "physics, chemistry and natural history, with explanations of their applications to industry and life," and included other courses such as "notions of economics and basic job skills, for the boys, and notions of household economics and point and sewing, for the girls."[6] However, this was not the required curriculum in other elementary schools around the country.

With the benefit of hindsight we know by the end of the imperial period, in 1889, Brazil was the largest country in South America and had one of the lowest literacy rates (16.6%). In some Brazilian provinces literacy rates were closer to 10% (Table 2), and our estimated enrollment rates (for population between 5 and 14 years old) are below 10% in most states (Table 3). Finally, there were two schools for every 1,000 school-age children in the country and in some states, such as Bahia and Ceará, there was only one school per 1,000 children (see Table 4).

Education During The Republic (1889–1930): Increases in Literacy in 1-2-3

In 1889, a Republican movement that overthrew the emperor in a peaceful revolution established a provisional government in charge of drafting a new constitution. Through the change in the legal framework and the rise of a new dominant ideology (positivism), the

[5] "Reforma Leoncio de Carvalho 1879," Decree 7247 April 18, 1879.

[6] See Decree 7247 April 18, 1879, Article 4.

Republican government brought about a major reform in the way schooling was financed and organized.

Among the most important issues discussed during the Constitutional Congress of 1890-1891 was the distribution of tax revenues among the federation and states. The debate was not focused around whether Brazil should be a federalist republic, but rather how decentralized the federalist system should be. In the federal government's initial proposal, export taxes were to be the exclusive responsibility of the state governments, but only for a period of seven years (between 1891 and 1898), and states were prohibited from taxing exports in transit from other states, although interstate taxes were not explicitly prohibited. The proposal also permitted states to levy taxes on rural land and property transfers.

Yet, following a series of negotiations, the commission charged with drafting the constitution announced a compromise on February 24, 1891. A coalition of exporter states that included São Paulo, Minas Gerais, Rio de Janeiro, Bahia, Pará, and Amazonas defeated a more disorganized coalition that included sugar exporting states in the northeast and the cattle-exporting state of Rio Grande do Sul (Costa 1998). In fact, the bargaining power of the winning coalition stemmed to a large extent from the fact that the commodities those states exported, such as coffee and rubber, had significant booms at the end of the nineteenth century. Martinez-Fritscher (2009) argues that the economic power of the local elites made the threat of leaving the federation credible enough to allow them to push for a decentralized constitution.

The Constitution of 1891 also gave state governments the responsibility to finance education using their own resources. Education had been relatively decentralized since the Empire (Hilsdorf, 2003 and Moacyr, 1939), but after 1891 states were in charge of taxing their own exports to finance the expansion of public education. Table 8 shows that from the Empire to the Republic there was an increase in real expenditures on education per capita of almost 80% on average.

After 1890, the international price for commodities such as coffee and rubber increased rapidly. As a result, states that had the natural endowments to produce and export those commodities collected higher export tax revenues and were able to spend more on education per capita. Table 2 shows that the states that had higher average expenditures on education per capita or per school-age children, between 1889 and 1930, were those that exported rubber,

coffee, and cattle. States that exported coffee and rubber, for instance, spent more than 2.5 times what sugar-exporting states spent per capita (and over 3.5 times what cotton exporters spent). The same differences across states is clear when we look at the number of schools per thousand children, a figure closely correlated with the level of export tax revenues per capita.

The education system in Brazil underwent a radical transformation throughout the Republican period. First, ministers of the interior or of education in the states gradually changed the way schools worked. From the Lancaster method in which in one room students from all ages studied together and helped each other learn with the guidance of one teacher, Republican governments in the states started to modernize schools, introducing the idea of having one teacher per subject and one subject at a time in the schedule. These changes required changes in the buildings as well. Schools could no longer consist of one large room, they required specialization of certain spaces, a separation of students by grades, and the creation of spaces like labs, gyms, and libraries. Obviously not all the states could provide all of these facilities in all of their schools, but gradually schools in large cities started to converge to the new school layout and the new schedule.[7]

The results of an increase in the fiscal capacity of states to spend in schools and the ideological drive to change the schooling system led to significant improvements in school enrollments, teacher-pupil ratios, and the number of schools per children enrolled. Enrollment rates in elementary school, defined as the number of students enrolled over the population of children from 5 to 14 years old, went from 6% in 1889 to 23% in 1933 (Table 3). Some states had significant increases in enrollment (especially richer states) and even when smaller or poorer states tried to keep up, they lagged behind in the long run.

The transformation of state education during the Republic, we argue, had persistent effects in the twentieth century and help us to understand regional inequality in education today. For instance, Table 15 shows the ranking of states according to literacy in 1872, 1890, 1940, and 2007. It shows that the states that had the largest windfall profits from export revenues managed to keep their ranking or moved up in the rankings in a significant way

[7] To understand the basic modernization of schools during the republic see Rosa Fátima de Souza, *Templos de civilização: a implantação da escola primária graduada no Estado de São Paulo, 1890–1910*, Sao Paulo, UNESP Fundação, 1998, pp. 16–17.

before 1940 and stayed there for the following 70 years. Meanwhile, states that did not have a favorable trade shock between 1889 and 1940 lagged behind and lost places in the rankings. Those states are still the ones with lowest literacy rates in Brazil.

We give credit to state governments for most of the increase in enrollment rates during the period under study. The elementary school system during the republic was divided into four: private schools and state, municipal, and federal schools. Since independence in 1821 most of the elites attended private schools; in most towns and cities private schools were perhaps the best providers of education. Yet, Table 6 shows that most of the increase in enrollment between 1907 and 1933 took place in schools sponsored by their state governments. Municipal governments also increase in importance, but their increase was marginal. In fact, the advance of state-sponsored schools was such they gained market share from private schools. Between 1907 and 1933 state schools increased their share of total students from 54% to 65%, while private schools lost share, going from 24% to 18% of the total student body.

The increase in the number of teachers is perhaps a better indicator of the speed at which state governments invested in education. Table 7 shows the pupil-teacher ratios at the state level in the whole system and in state schools. The pupil-teacher ratio is defined here as the number of school-age children (5 to 14 years old) over the number of teachers of elementary education. We can see in this table that the pupil-teacher ratio for the whole school system actually increased from 31:1 in 1907 to 38.6:1 in 1933. This is because the number of enrolled students during the period we study increased at a breakneck pace (e.g., from 1889 to 1933 enrollment increased 757%). Therefore the increase in the number of teachers necessary to keep up with enrollment was significant.

In fact, teacher-pupil ratio in schools funded by state governments decreased between 1907 and 1933. That means that the increase in pupil-teacher ratios at the aggregate level happened because private, municipal, and federal schools could not keep up with increases in enrollment (and because private enrollment as a % of total was also falling). This is quite an accomplishment for state schools because it implies state governments were able to train and hire teachers in a number large enough to keep up with enrollment rates. It is even more astonishing if we remember that state schools were also gaining market share during this period, so they faced increases in enrollment higher than those of other schools.

The Exogenous Drivers of Public Expenditures on Education in Brazil, 1889-1930

In this section we show that the fact that the Constitution of 1891, by allowing states to collect export taxes, led to significant differences in export tax revenue per capita per state and, as a result, large disparities in the level of expenditures on education among the states. We argue that the boom in the demand for certain commodities in international markets induced an asymmetric trade shock that favored some states more than others. Thus, in our view, a lot of the variation in export tax revenues, which were the main source of income for state governments, came from the variation in international commodity prices. We argue that since Brazilian states were price takers in commodity markets (except for coffee during some periods) we can use the international prices of commodities as an instrumental variable to explain the variation in revenues at the state level. Below we show that states that had higher export tax revenues per capita spent more on education; we also demonstrate that states that had higher increases in export prices were in fact the states that collected more revenues and spent more on education.

Data and Methodology

For the empirical section of this part of the paper we created a panel with data on expenditures on education, export tax revenues per state, population density, and imports per capita. To obtain fiscal and debt data for the different states of the Brazilian federation between 1890 and 1930, it was necessary to compile statistics from a variety of archival sources and published materials. The Appendix details the sources and methodology by which the key variables used in the present analysis were estimated. Below, we explain how we construct our main dependent variables and the empirical strategy used to estimate the determinants of public goods expenditures for Brazilian states.

Empirical Strategy

We start by running a simple OLS regression using panel data. Our basic specification for examining the determinants of expenditures on education per capita by state is of the following form:

$$ee_{it} = \beta_1 s_{it} + \beta_2 colonial * s_i + \delta X_{it} + \zeta_i + \varphi_t + \varepsilon_{it},$$

where ee_{it} is the log of expenditures on education per capita in state i in year t, s_{it} is the log of export tax revenue per capita for each state i and year t. *Colonial*si* is an interaction term that uses proxies for colonial institutions (cross-sectional) and multiplies it by export tax revenues per cap. The variables that proxy for colonial institutions include the percentage of slaves to total population in 1872, population before the arrival of the Portuguese, measures of land concentration, and dummies that capture when the main commodity produced in the state relies on plantation agriculture and/or slave labor (for precise definitions see Panel C of the Appendix).

In our panel estimates we also include a vector of state characteristics, X, which includes imports per capita, population or population density, and state debt per capita. Most specifications include fixed effects (ζ_i) to control for state unobservable characteristics and year dummies (φ_t) to account for time varying trends common to all states (in some specifications we include state trends as well).

The main coefficient β_1 should be interpreted as an (export) income elasticity for state governments that tells us, in percentage points, how much expenditures on education would increase given a 1% increase in export tax revenue. We use the natural logarithm of the variables because given the number of states in Brazil and the variance among states we had outliers biasing the results. Working with natural logs we know most variables follow a normal distribution.

We believe it is important to control for imports per capita because it allow us to control for factors that may have determined the demand for education. Including such a variable helps us capture, for example, the increase in GDP per capita at the state level since we think imports had a high elasticity of income in Brazil during this time. Also, as the average family got richer it was easier to send their kids to school. Thus, imports per capita may also help us to control for other factors driving the demand for education, such as the industrialization level in the state and even the skill premium in a state relative to the average wage in the country. It may not be the best variable to capture all of these effects, but given the data limitations, especially to build a panel, we think this variable is the best we can do to control for some of those factors.

Additionally, we include either fixed effects or interacted variables to control for initial conditions at the state level. We understand that even if the type of commodities states could

export and the prices of those commodities were determined exogenously for each of the states, the amount of state tax revenues devoted to education may depend on initial conditions at the state level. For instance, politicians may spend less on education per capita in states with higher initial levels of education or in states in which the there was more inequality in the distribution of assets (e.g., land) (Engerman, Mariscal, and Sokoloff, 2009). Moreover, perhaps in states in which there were more slaves before emancipation (1888), elites would want to restrict education for blacks, a phenomenon that took place in the south of the United States for decades after the Civil War (Margo, 1990). Beyond including state fixed effects in most of our panel estimations we also include interactions of export tax revenue and the so-called colonial institutions. Finally, we also do some robustness checks in which we include variables to control for state trends or run diff-in-diff regressions to eliminate biases that could come from differences in initial conditions and the state-specific trends.

Instrumental Variables Approach

Beyond using simple OLS estimations, we run a series of estimations using instrumental variables for three reasons. First, we want to ensure that variation in export tax revenues is attributable to conditions in the commodity market (and the natural endowments of a state that limit the kind of commodities that can be exported). Second, we want to isolate the exogenous variation in prices from possible changes in the tax rates at the state level, just in case there are political economy factors driving export tax rates that are endogenous to either endowments, colonial institutions, or the type of commodities a state exports. In fact, from the scant data on export taxes we have we know that most states had similar tax rates for the same commodity (the differentials were minimum according to costs of transportation). Third, we think there is a possibility of serial correlation in our estimates, it being likely that export tax revenue at period *t-1* is correlated with the error term at period *t*. For example, a permanent change in conditions (e.g., in preferences or competitiveness) in the international market for the main commodity export of state *i* could increase export tax revenue and, consequently, expenditures on public goods in *t-1*, which could persist through the error term in *t*, thereby driving up expenditures on public goods in period *t*.

Seeing how taxes on commodity exports account for much of state revenues, we want to find an exogenous factor that determines the export and revenue collection capacity of each

state (without affecting expenditures on public goods directly). Ideally, these would be geographical or climate-related variables that explain variation in state revenues per capita across states (i.e., why some states specialized in some and not other commodities) and over time in revenues, exports following cycles determined either by international conditions or changes in weather. Creating a panel with climatic variables (such as rainfall, temperatures, and barometric pressure), geographical variables (such as altitude and distance to the equator), and other geological variables (such as soil types, which determine which crops can be produced) would have enabled us to control for conditions that affected the supply of, but not demand for, commodities. Because the shock we want to capture has an important demand component, and weather data was largely unavailable for the period 1891-1930, we devise an alternative approach.[8]

We create a series of price indices that use variation in the prices of commodities exported by each state weighted by the share of exports each commodity represented for each state. Given the high degree of correlation between some of the geographic variables and the kinds of commodities in which states specialized, we assume the export shares at the beginning of our period reflect this heterogeneity across states, and use international prices to create an index of commodity exports by state, weighted by the export shares in the initial period.

We combine the information on commodity exports at the state level in the initial year with the variation in prices using the following approach. Brazil has I commodities, i=1,…,8, there are J states, j=1,…., 18, and we have T periods t=0,…., 1, where t=0 represents 1901. SH_{ij0} is the export share of commodity i at the beginning of the period (t=0) for state i. We transform the international prices for each commodity p_{it} to dollars and then calculate the growth rate (g) of international prices for each commodity, defined as $g_{it}= [(p_{it} -p_{it-1})/ (p_{it-1})- 1]$, where i and t are defined as usual. We use g_{iNt} to predict prices at state level, using SH_{ij0} as weights for a weighted price index per state, following the formula:

[8] We have only some of the geographic variables that do not change over time (e.g., altitude and distance to the equator). We found that the average of weather variables for a later period in fact does explain much of the cross-sectional variation, but for a panel estimation such as ours, these variables are equivalent to having fixed effects for the states.

$$\hat{P}_{jt} = 100\left[\sum_{i=1}^{I} SH_{ijo} * g_{it} + 1\right],$$

where $\hat{P}_{jt}$ is the index price for state j at period t. For each of the indices, 1901 is the base year (1901= 100).[9] We use a price index $\hat{P}_{jt}$ for each state as an instrument for state public revenue per capita in the first stage, the idea being that our price indices per state will reflect how much states can extract in ad valorem taxes on exports. In the second stage, we use our estimated state public revenues per capita as independent variable to estimate the expenditures on education per capita.

Using price indices of commodity exports, however, assumes that states did not influence the growth rate of prices in international markets, which is not necessarily true. This is problematic because São Paulo, Minas Gerais, and Rio de Janeiro, as price setters in the international coffee market, largely determined the growth rate of national coffee exports . As mentioned in the introduction, Amazonas and Pará were the principal suppliers in the international rubber market, but there was no coordination or any explicit effort to control prices; rubber exporters were price takers. To deal with the potential endogeneity in coffee prices, we construct alternative price indexes that ignore the price fluctuations for coffee (we do the same for rubber exports). We get similar results even when we exclude coffee or rubber from the price indices. Even when we remove from our sample for some specifications the data for the states that obtained most of their revenue per capita from coffee (e.g., São Paulo) and rubber (Amazonas) exports, the results support our hypothesis.

Findings

The findings running the OLS estimates show that increases in export tax revenues explain the increases in expenditures on education at the state level (see Table 9A). The results are impressive if we think about the differences in export tax revenue per capita according to

[9] The first year for which there are data for commodity exports at the state level is 1901. There being no evidence of compositional changes in the state exports during the 1890s, we believe that 1901 should be representative of the state of commodity exports in 1890.

the export boom different states experienced. Using the first two specifications we can build simple counterfactuals. For instance, if a state that exported sugar could change its endowments and export coffee instead, it would have a jump in revenues per capita of about 200-300%. Thanks to such an increase in revenue, and using the elasticities in Table 9A, we would expect an associated increase in expenditures on education per capita of around 90%. Yet this would convey the idea that the kind of goods states exported was what really mattered to drive export tax revenue. Even when we control for the composition of the export basket we find that the coefficient for export revenues per capita is still significant and of similar magnitude. In fact, most of the variables that control for the composition of the export basket are not significant. That means that it was not the composition of exports that determined revenues per se, but either the price ramp up or the capacity to export more volume (without changing the composition of exports) what actually drove export tax revenues.

Robustness checks

One concern with our estimation strategy is that we are not taking into account the trend in education expenditures in each state before 1889 and that the coefficients we find in our estimates with fixed effects are just artifacts of the average effect of those trends. For that purpose we pursue two additional estimations to make sure we put our hypothesis through the toughest test. In specifications 6 through 11 of Table 9A we run OLS specifications that include state-specific time trends, in addition to the fixed effects and the time dummies for all states. We then find that export tax revenue is still significant to explain increases in education expenditures, even if only at 10% significance. In specification 9 we have to take out the data for the state of Minas Gerais because we do not have data on its imports and in specifications 10 and 11 we take out states that exported coffee (Rio de Janeiro and São Paulo) and rubber (Amazonas and Pará), respectively. Across the board our coefficient for the logarithm of export tax revenue is weakened, but it is still significant at 10% and has a consistent size across specifications (with an elasticity closer to 0.10).

Another way to approach the same concern is to run a simple OLS using the average of the variables of interest. The results are in Table 9B. This simple cross-sectional regression should eliminate what we pick up from state-specific trends in our original estimates. Interestingly, the coefficient of export tax revenue per capita is of similar magnitude to those we

found using panel estimates with time trends. Therefore, we conclude that the elasticity is close to 0.1, that is, if export tax revenues increased 1%, education expenditures increased 0.1%.

Findings: Instrumental Variables

In order to show that the variation in export tax revenues is exogenous to the political economy of the state, and to correct for possible serial correlation, we run the same estimates using our export price indices for each state as instrumental variables (IVs). The results of our IV estimates in Tables 10 and 11 show a strong and significant coefficient. That is, the variation in export prices at the state level seems to explain the variation in expenditures on education. Again even after controlling for the composition of the portfolio (the average) we find strong coefficients in the first and second stages. This perhaps implies that what mattered the most were the price ramp ups. Most states had an export basket cemented at the beginning of the period of study, what seems to be driving export tax revenues are really the asymmetric price ramp ups across commodities.

Going beyond just expenditures on education, what we really care about is whether the increase in export tax revenue per capita or the price of exports can help us explain the improvements in education indicators over time. In order to check this we take two approaches. First, we average out all of our variables and run a simple cross-sectional regression (with limited sample size of 20) and check if average expenditures on schooling per capita are correlated with the change in literacy rates (1890-1940), in the number of schools (1890-1940), and in the number of students (1890-1940). We find significant correlations across the board, except for the change in the number of students, which is only significant when we control for many state characteristics (See Table 12). We then run similar regressions using panel data (table 13) and use our simulated export price indices at the state level as an independent variable, rather than just using export tax revenue per capita. We get consistent significant coefficients except for the specification in which we control for population.

In sum, our empirical strategy shows that state governments collected more tax revenue when they had increases in the prices of their commodities. Those states that had higher export tax revenues ended up spending more on education and having better outcomes such as higher literacy and enrollment rates or more schools. Yet, we have not explained why the political elites who controlled the government in the different states of Brazil would have incentives to

use the "windfall" profits of exports to pay for education for all. In the next section we examine the incentives of these elites.

Understanding the incentives of politicians

Colonial institutions and education expenditures between 1889 and 1930

Understanding the incentives that politicians had to spend on education in Brazil between 1889 and 1930 seems particularly important because the behavior of state politicians in Brazil during the period we study seems atypical. In a country with such steep inequality and in which the Constitution included a literacy requirement to vote we would expect elites to limit the provision of education to the elites (Engerman, Mariscal and Sokoloff, 2009; Lindert, 2004) . In fact, before 1889 most of the expenditures on education went to a limited number of schools and there were subsidies for certain private schools that educated the elites.

We examine first whether initial conditions mattered to determine expenditures on education. We look at whether the distribution of economic assets determined partly how much state politicians invested on education across states. For that purpose, we try to exploit the variation in state characteristics that include the percentage of slaves to total population by state (Engerman and Sokoloff, 1997), mortality rates by tropical diseases (Acemoglu et al., 2001), the percentage of land in the state in farms larger than 100 hectares (a proxy for the concentration of land holdings) (Engerman and Sokoloff, 2002; Engerman, Mariscal and Sokoloff, 2009), and whether the main commodity the state exported either relied on plantation agriculture or on some form of coerced labor in the nineteenth century or before (we follow the classification of commodities of Gallego and Bruhn, 2007). We run the same OLS regressions (with panel data) we presented in the previous section, but this time we add interaction terms that multiply export tax revenue per capita (ETRpc) by each of our variables measuring colonial institutions (see Table 14).

Our econometric estimates in Table 14 show that institutions seemed to have constrained the expansion of public education just like Engerman, Mariscal and Sokoloff (2009) assumed, but the net effect in most of the interactions seems to be positive. The interpretation of the coefficients with the interaction terms is facilitated by the fact that most of the measures of the so-called "colonial institutions" we include are between zero and one (e.g., percentage of

slaves and mortality rates). Thus, the addition of the coefficients of the interactions between export tax revenue per capita and the different measures of colonial institutions show that the latter constrained the expansion of expenditures on education, but only to a certain extent. A state with highly concentrated land distribution or one that had a large share of slaves among its population before abolition in 1888, and that exported a lot during the period we study, could have increased education expenditures in a significant way and could have in fact changed the long run growth trajectory of the state or its relative position in the ranking of states. In fact, in Table 8 we can see the radical changes in the ranking of states according to literacy during the period we study.

Another channel through which institutions may have retarded the modernization of the education system in Brazil, is by delaying the spread of the Republican ideology towards education, which is not easy to quantify. Thus, we believe that the negative coefficients in Table 14 may also be related to an ideological fight between Republicans and imperial elites who wanted to preserve the status quo. A good example is the state of Pernambuco where "ex-monarchists dominated state politics," and where "not a single historical Republican was elected governor" (Love, 1980, p. 112). In fact, Pernambuco started with one of the highest literacy rates within Brazil (in 1889) and then fell to the bottom of the rankings by 1930 because of lack of investment in education (see Table 15). On average Pernambuco devoted 7.1% of expenditures to education during the Republic, making it the state with the second lowest share of expenditure going to education. Pernambuco also had one of the lowest per capita expenditures on education, far below the mean for Brazil (see Table 2 and Table 8). In fact, we believe that the resistance by incumbent elites may be one of the reasons why the diffusion of the modern school system was uneven across states and over time.

In sum, we think that the empirical evidence shows that colonial institutions may explain why states did not improve their education outcomes even more, but do not explain why states in Brazil had such rapid increases in literacy, enrollment, and the number of schools. The positive effect of having funds coming from windfall export tax revenues dominated at the end of the day and allowed the expansion of the education system. Therefore, we need to understand the incentives politicians at the state level had to spend on education for a larger share of the population, rather than spending on other public goods that would benefit the elites disproportionately more.

Incentives for State Governments to Spend on Education

In this section, we examine three different hypotheses that may explain the incentives state politicians had to increase the supply of education and that are also related to increases in the demand for education. We look at the relationship between immigration, industrialization, and electoral politics and education.

Immigration and Education

There are at least two main channels through which immigration into Brazil could have driven state politicians to spend more on education between 1890 and 1940. First, immigrants arriving into Brazil could have demanded that the state governments spend more on education, either because they valued education more or because they wanted education to help their families and future migrants to adapt to Brazilian society and customs more easily. European immigrants, especially those who were literate, may have demanded more and better schools in the states in which they settled. Second, politicians at the state level may have spent resources on education as a way to attract immigrants. The 1887 U.S. Consular Report from Brazil shows that in addition to the subsidy for the travel cost, the Brazilian government was offering "the construction of roads, schools, and churches, as well as any other aid or assistance that may be judged necessary for the prosperity and development of colonial settlements." In addition the Brazilian government provided immigrants with "board and lodging for eight days, and free transportation from the port of their disembarkation to the locality to which they are going…" (p. 73, U.S. Consular reports, 1887).

There are many reasons to believe that attracting immigrants was a real motivation of state governments. For instance, coffee planters chose to subsidize emigration from European countries rather than from the poor states in the northeast of Brazil (Leff, 1997). Planters and the elite believed immigrants to be more reliable and more skilled than Brazilians from the northeast (Skidmore 1999). Moreover, there was significant concern among the elite about race, blacks formed the majority of the Brazilian population in some states, it could be argued that political elites may have preferred to increase the share of Europeans (whites) in the population (i.e., "whitening" Brazil) (Skidmore 1999; Santos 2002).

The timing of the mass immigration of Europeans into the country was closely related to the abolition of slavery and the expansion of the coffee economy. After 1882 the government of Brazil sponsored an immigration program aiming to attract European farmers and their families (to avoid return migration), mostly from Italy, Portugal, Spain, and Germany. Since the government of Brazil abolished slavery gradually between 1870 and 1888, coffee planters in the southeast of the country, especially in São Paulo, organized and demanded an immigration program that could facilitate the substitution of slave labor for European immigrants or that simply facilitated the expansion of the area planted into the interior of the country. The bulk of the funding for this program came from a special tax on coffee exports (Holloway, 1980; p. 69) and the contracts that both the state of São Paulo and the Brazilian government signed with shipping companies had no specific requirement in terms of human capital for immigrants, the only requirements for eligibility to transportation subsidies were related to age, gender and family ties.[10]

Almost five million people immigrated to Brazil between 1870 and 1930. The success at attracting immigrants to Brazil was partly because of the incentives that the federal and São Paulo state governments provided for shipping companies. Before 1900 these governments had agencies abroad and signed contracts with shipping companies that required the carriers to take a specific quota of immigrants from certain nationalities and who were either couples younger than 45 years old, without children, or couples or widows with at least one male in working age. Later on these governments established a ceiling for the number of subsidized immigrants that met the above conditions and the shipping companies paid for transportation costs and for the promotional agencies in Europe. Interestingly, there was no specific requirement in terms of human capital for immigrants, the only requirements for eligibility to transportation subsidies were related to age, gender and family ties (Holloway, 1990, p. 48–50).[11]

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[10] The countries of origin of the immigrants who settled in Brazil changed over time. During the first wave, 1880-1909, immigrants were mainly from Italy, Portugal, Spain, Germany, and the Middle East. During 1910-1929 immigrants were mainly from Portugal and to a lesser extent also from Italy, Spain, and Russia (Basto, 2000).

[11] In fact, almost half of the European immigrants that went to Brazil during the period we study were actually illiterate (e.g., 43% of immigrants living in Brazil in 1890 and 48% of those surveyed for the 1920 census). That implies that the increase in literacy during the republic cannot be explained solely by the inflow of immigrants, given that the literate immigrants represented only 12% of the total increase in

In sum, immigration could have shifted the demand and the supply of education, with the net outcome being an expansion in the provision of public education.

Testing the relationship between immigration and education

Testing whether immigration is behind the politicians push for education is complicated for at least two reasons. First, it is hard to test empirically if immigrants demanded more investment on education as they arrived because over time the number of immigrants could also have been endogenous to investments in education. Second, there are only two censuses that disaggregate the number of foreigners by state (in 1890 and in 1920), therefore making it harder for us to analyze the relationship between migration and education over time. Thus, we test the hypotheses outlined above using simple cross-sectional regressions and also the panel data estimation techniques we used in the previous section, but interacting the cross-sectional information we have on the percentage of immigrants by state with our measures of export tax revenues per capita. For all of this tests, we expected to find positive and significant correlations between our figures for immigrants per state (or percentage immigrants) and education indicators.

The cross-sectional evidence shows significant correlations between the number of immigrants per state and the percentage of immigrants per state and expenditures on education. Yet, there is no significant correlation between these our immigration variables and the pupil-teacher ratio or the number of state schools. We believe that if immigrants demanded anything in particular it would have been more expenditure on education, more infrastructure, or more teachers. In Table 17, however, the correlation between the number of immigrants and variables that measure the actual provision of education are not significant (the estimation is limited because we use the averages of the variables we have in a cross-section regression with only 20 to 22 observations). Only in Table 18A do we find a significant correlation between the number of immigrants and school expenditures, yet the significance weakens (to 10%) when we control for population density. We lag the explanatory variables five-years to understand whether the increase in the state government's investment in education was a response to the

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literacy in Brazil between 1890 and 1940. This last fact is a consequence of Brazil's immigration policy, which favored the importation of families of relatively poor and illiterate farmers from Italy, Spain, and Portugal, and some more educated farmers from Germany.

wave of immigration (and the related increase in school-age children), and to what extent it may be related to the aim of integrating foreigners).

We also examine if the change in the composition of immigrants had an impact on the expansion of the investment in education and find significant coefficients, but that are rather weak. In order to examine the integration of immigrants we construct an index of integration that measures the cultural proximity of immigrants by doing a weighted average of a series of characteristics of migrant groups from different groups. We weight these characteristics equally for migrants from each country of origin and then estimated a weighted average according to the number of immigrants from each country (as a percentage of total immigrants). [12] The index goes from 0 to 100. We then use the index as an independent variable in a regression that has expenditure on education as the dependent variable and that relies on cross-sectional data from the census of 1920 (with a limited sample of 20 to 22 observations) (see Table 17). The coefficient for the index of immigrants' integration is statistically significant but close to zero. We can observe that neither the number of immigrants nor the shift in composition of immigrants over time, from European to Asian, had a significant impact on the increasing involvement in the education sector by the Brazilian government (with the exception of the significant effect of the index on expenditure, but the coefficient is close o zero).

Finally, using our panel of export tax revenues we find evidence that weakens the immigration link to education expenditures. When we run OLS regressions using education expenditures as the dependent variable and including an interaction term between export tax revenue per capita and the percentage of immigrants per state in 1890 we find a negative

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[12] The index of adaptation and assimilation of immigrants within Brazil includes the following elements: a) Institutional integration [vote: indicator for the existence of voting restriction for immigrants; immigration regulations and laws for specific countries of origin: indicator for the existence of specific anti-immigration laws]; b) Acculturation [Language: score (3=Portuguese; 2=European language; 1=other) European heritage: indicator if immigrant's background is European; Religion: indicator if Catholic religion]; and, c) Adjustment and integration of the immigrants [wage with respect to natives in the cotton industry (industry census 1920); share of workers in management position (industry census 1920); business ownership (industry census 1920); share of immigrants who stay in the country (estimates available on return migration by nationality from Klein (1995) and Santos (2002))]. For every migrant group (by country) each component is weighted equally and then the index is build by adding up the data for all immigrant groups and weighting the data by the relative size of each group (immigrants of each country to total immigrants). Finally, the index is normalized to vary between 0 (no integration) and 100 (integration).

coefficient. This implies that the states that had more immigrants at the beginning of the Republican period used less of their windfall export tax revenues to increase expenditures on schooling. This is particularly important if we take into account that a large wave of European immigrants arrived to Brazil before 1890 (see Figure 1 and 2). Even if this is a test that only looks at initial conditions it should not be discarded; in doing this test using panel data we are controlling for many observable and unobservable characteristics of the states, as well as time dummies, that we cannot control for in our cross-sectional regressions (because of the small number of observations).

In sum, the evidence on the relation between immigration and expenditures on education or the number of schools or teachers is rather weak. Perhaps this has to do with the fact that some of the states that spent more on education during this period received few immigrants (e.g., Amazonas), which may make the average correlation between immigration and education weak.

Industrialization and Education

Another explanation of the changes in education expenditures at the state level could be the result of increasing demands to improve the provision of public education as a way to provide industrialists with skilled labor. In the same way, as states industrialized, productivity and incomes increased and families perhaps demanded more public education. In this section we test whether there are clear correlations between industrialization and the increases in expenditures on public schools, or between industrialization and education indicators.

After 1890 Brazil experienced a period of rapid modernization. The industrialization of Brazil before 1940 greatly relied on textile, as well as on manufactured goods such as clothing, food products, beverages, and tobacco. Among the factors that led to the industrial expansion were the improvement in transportation, the increased urbanization that created a consumer market, the concentration of capital, as well as the progressive shift from water power to steam power (Musacchio, 2009). Apart from the large-scale factories of the textile sectors, production in the other industrial sectors remained concentrated in small-scale factories (Skidmore 1999). The growth in the number of industrial establishments, of capital invested in industrial ventures, and in industrial output was concentrated in the South and Southeast of the country.

One hypothesis is that the development of the industrial sector created more complementarities between skills and technology, leading to a shift from the capital-technology to the skill-technology complementarities. Goldin and Katz (1998) suggest that it was the introduction of technologies known as batch and continuous-process in the manufacturing sector that led to more complex methods of production and to greater technology-skill complementarities. In the case of Brazil it is possible that the process of modernization required a more skilled and disciplined workforce than the one needed in the agricultural sector.

Yet in sectors in which basic technologies are employed for production we do not expect industrialists to have needed skilled workers due to the technology-skill substitution (Goldin and Katz, 1998).[13] Thus, we may also find that there was not significant correlation between industrialization and the expansion of education, simply because industrialization did not required skilled labor.

We test whether industrialization and the need for skills drove expenditures on education and the expansion of education infrastructure in three different ways. First, in Table 18A, we run a regression in which we look at the correlation between expenditures in education at the state level and capital invested in industry per state (i.e., the stock of paid up capital from the 1920 census). This regression, shows no significant correlation between these two variables. So it does not seem like the most industrialized states (measured as paid up capital of the industrial sector) are the states that invested more on education. Paid up capital, however, is an imprecise measure of industrialization because it can be overstated or can have little to no relation to actual output and industrial employment.

We explore this further by looking at the relationship between industrialization and our measures of expenditures in education using our panel estimation approach. Through this method we think we can control for more of the observables and some of the unobservable heterogeneity at the state level. The dependent variable is expenditures on schooling per capita; we look at the effect of industrialization by interacting our series on export tax revenues with industrial output in 1907 (as a measure of initial industrialization), the change in industrial production between

[13] This may also be expressed in terms of relative distance to the technological frontier, which required a workforce with less skills and human capital in general (Vandenbussche, Aghion, and Meghir, 2006).

1907 and 1920, and the change in industrial production from 1907 to 1940. These estimates appear on Table 16. We find that all of the measures of industrialization are significantly correlated with expenditures on education per capita, but they have a negative sign, meaning that the states that industrialized the most were not necessarily those that spent more on education. This is partly explained because some of the poorest states, which were not industrialized, made a tremendous fiscal effort to spend on education to keep up with literacy in other states (in the next section we give some hypotheses of why that was the case). Table 8 shows how much states spent on education as a percentage of total expenditures and it is clear that some of the poorest states such as Ceara, Alagoas, Sergipe, and Paraiba, were spending more than 10% of their budget on education. In fact, Ceara spent almost 20% of the budget on education throughout the period. So far we do not find evidence of a positive correlation between industrialization and education, on the other hand, by including a large set of controls in our data setting we find negative correlations, which implies that more industrialization is correlated with less expenditure on education.

In order to provide a better understanding of this effect we are going to examine more closely the skill-technology complementarities and the nature of technology across the different industries. We start by looking at the correlation between skill premiums and education indicators[14]. The logic is simple: states that were more industrialized during the period we study needed more skilled labor and thus had a higher skill premium, i.e., a higher wage differential between skilled and unskilled labor, and thus required more expenditures on education and, therefore, should also have more education infrastructure. Galor and Weil (1999, 2000), argue that the acceleration in the rate of technological progress gradually increased the demand for human capital in the second phase of the Industrial Revolution, leading parents to invest in the human capital of their children. Thus, we look at the correlation between skill premiums and other measures of industrialization related to industrial output and education expenditures, enrollment rates, and the number of schools. We take a broad definition of skill premium as the difference in wages between the top income earners in the census, e.g., administrative workers, and some of the lowest income earners, e.g., industrial workers, through which we can get an

[14] Due to data limitations it is not possible for us to estimate returns to literacy before and after government intervention similarly as Mitch (1984) did for nineteenth century England.

idea of the premium in salaries educated workers received. Ideally we would want to use figures from the lowest income earners, say day laborers, and compare it both with factory workers and with administrative workers, yet the data we use is more complete and accurate for the comparison of the latter two categories only.[15] Overall, we find positive correlations between skill premiums and other industrialization measures and education indicators and more mixed evidence when we examine the correlation between skill premiums level and our education indicators at the state (Figure 3). Our skill premium measures are highly correlated with education expenditures and the increase in the number of schools, i.e., there is evidence that in more industrialized states the local government spent more and ended up providing more education infrastructure. Due to data constraints we cannot formally test how much the technology-skill complementarity has affected the skill premium in the Brazilian states during the period under study. This is because the early Census datasets we are using do not provide information on the level of education/skills of the workers employed in the different sectors of the economy. However, we are going to provide a description of the technology available in Brazil which may shed some light on how the evolution of technology has created dissimilar capital-skill complementarities, and favored either skilled or unskilled labor by increasing their marginal productivity and the overall demand.

During the nineteenth century most of the technology used across Brazilian industries was imported (De Oliveira Birchal 1999). The dependence on imported technology to promote industrialization and economic development also led to the difficulty often faced by entrepreneurs of adapting foreign technologies to the availability of local resources (De Oliveira Birchal 1999). Maddison (2001) suggested that during this time in Brazil there was no formal attempt to expand technical education. In this regard, technical competence and knowledge for the successful adoption of new technologies and appear to be more closely related to specific training and experience rather than to general elementary education. This also had the effect of creating a demand for foreign labor force needed to install and maintain the equipment and machinery. This varied across industries depending on the level of specialization of the imported

[15] The census data is the only consistent source of salaries across states. To our knowledge there is only one study that has looked systematically at the skill premium and it focuses on the state of São Paulo. See Molly Ball, "Origins of Industrial Inequality: São Paulo, 1889-1930," paper presented at the 2009 Congress of the Latin American Studies Association, Rio de Janeiro, Brazil, June 11-14, 2009.

technology. The textile sector for example, which represented the most important industrial sector until the 1930s, mostly relied on technology imported from Great Britain and the United States. De Oliveira Birchal (1999, p.171) describes how often foreign technicians were hired for the installation and maintenance of the equipment and how in the case of the *mineiro* textile industry often the contract for the purchase of machinery for the mills included the provision of a technician to assemble and operate the equipment.

From 1840 onwards textile factories were hiring more foreigners with the aim of improving the quality of the labor force employed by having more skilled ("especializados") and also because they could teach to the more unskilled local workforce employed (Stein 1979). After 1890, Portuguese and Italians replaced English immigrants working in textile factories. However, this does not imply the existence of a skill-bias technology given the fact that low-skilled labor remained the majority of the workforce employed in the textile sector and the fact that the complementarity between capital and skilled labor has always existed in the "machine-maintenance segmentation of manufacturing" even for less advanced technologies (Goldin and Katz 1996, p.212).

We now show the evolution of technology imports for a small number of industries. Given data limitations we cannot draw any definitive conclusions but we believe that this can provide some insight on the changes in the skill-technology complementarities over the time examined. Following Goldin and Katz (1996), we divide industries according to the education distribution. Specifically, we divide the industries for which we have data on technology import between those that are the product of the first industrial revolution (i.e., textile and wood machinery), which require low levels of education, and the more recent ones, product of the second industrial revolution, (i.e., machinery for energy and electric equipment) that rely on a more skilled labor force[16]. From Table 18B it is possible to observe that the greatest increase in import of technologies has occurred in the sectors that have remained largely labor-intensive and low-skilled.

[16] This only provides an intutition as the underlying assumption is that the share of domestic production of technology with respect to imports has changed in the same way across industries.

In this regard, it is not clear that in the more industrialized states enrollment rates were significantly higher. Even if there was a high skill premium (i.e., more incentives to go to school), people chose not to send their kids to school to have children helping the family either in the household or in the productive activity. Compulsory schooling was introduced in 1879 but non-compliance was high especially in rural areas. The history of industrialization in Brazil shows that child labor was significant between the end of the 19th century and the 1920s: in Sao Paulo for example, children represented 15 percent of the industrial workers in 1890 and 40 percent of workers in the textile sector in 1920 (ILO 2006). Brazil had widespread child labor in every state, particularly in the countryside, and lagged behind in the introduction of child labor laws (Doepke and Zilibotti 2005)).

Moreover, it seems unlikely that the elite deliberately attempted to support the expansion of education with the aim of industrializing the country given the prevailing ideology of liberalism (i.e., the Manchester-style liberalism) and also the early opposition of urban merchants who had an incentive to maintain a dependence on imported manufactured goods (Skidmore 1999, p.92). In addition to this, industrialization mainly occurred without government support until 1930, given the reliance on free trade and the creation of tariffs with the only aim of generating revenues (Skidmore 1999, p.84).

So far we have examined the effect of industrialization on schooling, focusing on the effect of industrialization on development along a number of dimensions related to human capital. We acknowledge the existence of a possible reverse causation, and an effect of education on industrialization. Among others, Temple and Voth (1998) examine the link between human capital, industrialization and equipment investment and develop a model based on Murphy et al. (1998) that shows that the pattern of industrialization is determined by the accumulation of human capital, that is, higher levels of human capital make the cost of the adoption of new technologies lower. In this regard, Becker et al. (2009) show that Prussian regions with higher levels of human capital were those that more quickly adapted to the technological change and catched-up with Britain in the early 19th-century. This was mainly determined by the fact that Protestantism led to higher school enrollments and created the conditions for a faster industrial development. As a preliminary check for reverse causality we regress our schooling expenditure variable (with and without lag) on capital invested and we find that the coefficient is not significant (regressions not included in this paper).

Even if it is hard to disentangle a clear line of causality from industrialization to more education or vice versa, overall we do not think the evidence we have supports the argument that industrialization drove education expenditures (and vice versa). This is because of the nature of technology in the leading sectors of the economy does not seem to have created a demand for more skilled labor during the period examined. Moreover, the nature of the imported technology may have created the demand for more technical education rather than general education for which we do not observe a significant expansion during the time examined. In the next section we provide an alternative hypothesis of why politicians and political parties at the state level wanted to spend on education that is related to political incentives.

Political Economy of Education

Finally, we examine another motivation for politicians to spend on education, which was had to do with the desire to increase the number of adult males who could write and, thus, could vote. Brazil had a literacy requirement to vote since 1882, a fact that economic historians have identified as an explicit barrier for the masses to demand public goods such as education in many countries (Lindert, 2004; Engerman, Mariscal and Sokoloff, 2009). Yet the electoral system of Brazil after 1891 introduced direct elections at all levels of government (including national elections for presidents and state gubernatorial elections), a change that we argue increased the competition among states and, accordingly, increased the incentive to provide public goods and to teach people how to read and write.

Therefore, there are two channels through which the political economy of elections pushed political parties and politicians at the state level to spend on education. First, there was a straightforward patronage channel. As Queiroz (1977) summarized it, "from voters to politicians there was an exchange of services, a reciprocity…" due to the fact that "a vote from these citizens constituted a good, with a known value, which allowed them [voters] to bargain for favors and other benefits" (pp. 160-161). Thus, politicians may have traded votes for public goods, such as education.

The second channel through which the political economy spurred politicians and state political parties to spend on education follows from the fact that votes for national elections were worth the same in all states. In order to mobilize voters, states needed to increase the

number of literate adult males, which required improving the education standards. Since the Saraiva Law of 1881, registered voters in Brazil had to prove they could write their name and the date when they registered (there were fixed periods every year to do the registration). The Law also increased the income requirement to vote from an annual income of 100$ (about US$43) to 200$ (US$85).[17] When the Republican movement overthrew the imperial government in 1889 a presidential decree (Decree 6, November 1889), eliminated the income requirement but left the literacy requirement intact. In the following year, Decree 200-A, known as the Regulamento Lobo, introduced direct elections for the Constitutional Congress and simplified the process to recruit voters, rather than having a judge check the income and literacy, after 1890 an elected justice of the peace was in charge of doing an exam that usually asked citizens to write the date and their signature or to apply some other test, "always quick," that may have been deemed necessary.[18]

State politicians and, especially, state parties had incentives to increase the number of voters they could mobilize for national elections because most of the electoral competition was not within states, but across states. That is, there was no intense competition among states to control the presidency itself, but to gain favors or protection from the parties that controlled the presidency. The traditional historiography of Brazil calls the Republic the *café com leite* period, in

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[17] The Saraiva Law, Decree 3029 of 1881 established the literacy requirement as a necessary condition to vote and explain the procedures for the registration of new voters in the local electoral district (called *paroquia* or parish). The municipal judge would have to check the income of the individual, which had to be 200$ a year (higher than the 100$ a year tha prevailed since independence), and the potential voter had to write down his name and the date. Only adult males that met these two conditions could vote (with some exceptions for students of the school of officers of the army and other Brazilians with higher education). The law also introduced a secret ballot (i.e., ballot boxes where voters deposited their votes) and a registry in which those who actually showed up to vote had to sign their names again.

[18] See Decree 200-A, February 8, 1890 for the specifics. The requirement to sign and write the date was harder than what one may think today. The way to write the date in Portuguese at the turn of the twentieth century probably involved writing something like this "On this day 8 of January of the year of our Lord Jesus Christ of nineteen hundred…" Something that would be challenging for someone who had not taken basic elementary education.

Levine (1998) argues that the process of registration for new votes was controlled by local political bosses and that, therefore, some people got into the voters registry without knowing how to write, just to facilitate the mobilization of voters by these local bosses. Yet our data, taken from the census, shows high correlations between expenditures on education or education outcomes and the number of voters in different elections. That is, if there was a bias in the number of voters registered by local bosses, the bias was similar in all states, it was minimal, or the bias also affected how the census of population was conducted.

which the Partido Republicano Paulista (PRP) and the Partido Republicano Mineiro (PRM), the Republican parties of the states of Sao Paulo (a coffee producing state) and Minas Gerais (the largest producer of dairy products) respectively, alternated the presidency between themselves without any major challenge from other state parties until 1930.[19] Thus, the dominant parties in the states used their capacity to mobilize voters as a bargaining chip to negotiate concessions with the PRP and the PRM.

The exchange of favors and concessions between state parties and the dominant coalition in the federal government turned into a more formal, yet never codified, agreement in 1902. In 1902, President Manuel Ferraz de Campos Sales forged an agreement with governors and state parties through which, in exchange for support in national congress and for votes in the presidential elections, state politicians got concessions. The kind of concessions a state politician asked for in such a decentralized federation were: no military intervention from the federal government, the deployment of less federal soldiers in their states, subsidies to build railways or ports, or help to block state opposition parties using the President's influence in Congress. For instance, contested elections for national senators and congressmen had to be scrutinized by national congress. Therefore, the dominant block in Congress, usually controlled by the president, could help a state party to annul the election of an opposition candidate on some technical ground. This practice was commonly referred to as "beheading."[20]

Moreover, according to some accounts elections at the state level were not too contested, although it varied state by state and over time. Love (1980) shows that in São Paulo the PRP won all the elections from 1892 to 1930 with almost 100% of the vote.[21] Yet Levine (1978) shows that at least three gubernatorial elections in Pernambuco were relatively contested (with the 1910 election generating enough conflict to lead to a federal military intervention of the state).

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[19] In the election of 1910 the PRP and the PRM could not agree on a candidate and the PRM forged an alliance with the Partido Republicano Conservador to support Hermes da Fonseca, who ran against Rui Barbosa, the candidate of the PRP. Even if this was not necessarily a PRM-PRP president, the PRM managed to stay in the ruling coalition. By the election of 1930 the PRP-PRM alliance weakened completely after a coalition of parties from states other than São Paulo and Minas Gerais complained about the way in which presidential elections worked, organized a revolt, and annulled the election, leaving their candidate, Getúlio Vargas, in power. For a basic overview of power relations among states see Fausto (1999), p. 265-267.

[20] See Porto (2002), p. 196 and Fausto(1999) pp. 258-259

[21] See Table 4.3. on p. 143.

The revision of electoral irregularities that the National Congress did after each election also shows some variation among states.

Presidential elections were usually won by the dominant national party by wide margins across states. Most of the vote counts show landslide victories for the presidential candidates that the PRP and the PRM postulated, and even for the candidate of the Partido Republicano Conservador (PRC) in 1910, when the PRP and the PRM could not agree to back a candidate and the PRM forged a new alliance with politicians from the southern state of Rio Grande do Sul and backed the candidacy of an army Marshall for president.[22]

In order to test our argument that expenditures on education were made in order to increase the number of potential voters at the state level (either by increasing literacy rates or by enticing people to register in exchange for receiving public goods) we look at two pieces of evidence. First, looking at the real expenditures on education per capita before and during the Republican period in Table 8 we can see that there was a significant increase (of almost 80%) in expenditures per capita across states. Obviously those states that exported commodities that yielded higher export tax revenue increased their expenditures more, while many states that did not have significant increases in revenues (e.g., those exporting cotton, sugar, and tobacco) did not increase their expenditures on education in real terms.

Second, we devise a panel OLS estimate similar to our original specification of the determinants of education expenditures, but using measures of electoral participation as dependent variables. We hope to find a strong correlation between expenditures on education and the number of voters in the state or the ratio of voters to total population. We also include our simulated export price indices per state as an independent variable, as a proxy for expenditures on public goods, in case there could be endogeneity (because as the number of voters increased they could have demanded higher expenditures on education). The idea is that states that saw their export prices go up faster collected more revenues and spent more on education, thus increasing the number of voters in the state. There could be other channels through which higher prices for commodities could affect the number of voters, but we doubt that the increase in the number of voters could affect international commodity prices.

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[22] See for instance the vote count in the *Diario do Congresso* on June 27, 1902.

Table 19 shows the results of the regressions with the number of voters as the dependent variable. We have added a variety of controls in the different specifications. It is important to note that the dummy for the Republican period is included to differentiate the number of voters in 1875 and those of the 1910 and 1934 elections. This dummy has a high and strongly significant coefficient, meaning that political participation increased during the republic. Moreover, expenditures on schooling are highly correlated with voters, a 10% increase in expenditures per capita increased the number of voters about 4%. Also the coefficient for our export price indices is highly significant in most specifications and implies an elasticity of almost 0.8 (i.e., increases in prices of 1% increased the number of voters by 0.8%). The panel has only three cross-sections that are far apart from each other, so the changes we find within states (when we include fixed effects) imply changes over long periods of time.

The fact that we find a strong correlation between education expenditures and the increase in the number of voters (and likely causality) implies that politicians and parties at the state level had a long-term horizon in mind when they made investments in education. Their short-run interests were clear; they were spending on public goods, including education, to entice people to vote for the political candidates the dominant parties supported. Yet, one may wonder why politicians were investing in education to increase political participation in the future. The answer we think lays in the fact that state politics were dominated by political parties and not necessarily one politician or a series of politicians. That means that political parties were likely to be behind these decisions to invest in human capital.

How can we be sure that the changes we find are due to electoral competition and that it is not that state politicians behaved in the same way before there were elections. There are two pieces of evidence to help us. First, in the panel regressions in Table 19 we included a dummy for periods after 1890 that shows that the increase in the number of voter is faster during the Republic than before. Second, in Table 20 we include a panel regression that has data before 1890 to show that there was a significant increase in expenditures on education after 1890. That is, after 1890 state politicians spent more on education every time their revenues increased than before. We think that also contributes to the view that electoral competition changed the incentives of state politicians.

Now, the objective of politicians was not only to increase literacy among adult males. We also find that literacy rates for females also increased rapidly between 1889 and 1930, even if

women were not allowed to vote. This may be due to two reasons. One, maybe state politicians were providing education for all as part of the clientelistic or patronage relations they had with voters. Two, perhaps politicians knew that educating women facilitates the education of literate male adults in future generations (Fernandez and Olivetti, 2004).

Conclusion and Implications in the Long Run

In this paper we have shown that there was significant progress in the provision of elementary education in Brazil and that is was to a large extent a consequence of the fact that some states got more taxation powers and had the obligation to spend on public education. We think that the contribution of these findings is at least twofold. First, the fact that there can be trade shocks that alter the development trajectory of a state in a significant way, despite the legacy of colonial institutions, is important. Few of the works that defend the persistent effect of colonial institutions discuss in depth the kind of shocks that actually can change the development trajectory of a country or in this case, a state. Acemoglu, Johnson, and Robinson (2005) provide examples of how a trade can alter the relative power of elites and lead to significant institutional change that can lead to higher growth rates in the long run (e.g., in England in the seventeenth century). We argue that initial conditions (or the so-called colonial institutions) were strong constraints to increase education expenditures after states received windfall profits from taxing exports, but at the end of the day our econometric work shows that windfall tax revenues had a net positive effect on education expenditures. In fact, we explained how the elites of coffee and rubber states got together initially to change the constitution, introducing electoral contests for a large number of public posts. This competition provided the incentives for politicians to invest in education later on.

Second, the advances that we describe in the provision of public education happened despite the fact that there was a literacy requirement to vote. In fact, we argue in the last section of the paper that competition in national elections and the literacy requirement may have provided the right incentives for state political parties and state politicians to spend on education in a way that increased literacy rates in a significant way over the period we study.

The fact that the great leap forward in education was financed by taxing commodity exports is important because there is a long discussion among social scientists on whether there

is a so-called "resource curse" (Sachs and Warner, 1995; Wright and Czelusta, 2004; Lederman and Maloney, 2008; Haber and Menaldo, 2010). A broad definition of the resource curse, beyond the fact that countries with abundant natural resources tend to have slower growth, would argue that countries that have abundant natural resources develop rentier mentalities that can prevent them from investing in productive capacity in the long run (e.g., leading them to have low investment in education). In the case of Brazil we show that the states that had the highest price hikes in their main exports used more of their tax revenues to invest in education. Nevertheless, we qualify the findings by saying that states with less initial inequality (e.g., less slaves or less concentration of land holdings) increased their expenditures on education more, and that the incentive to increase these expenditures came from political competition. Therefore, our findings support the idea that there is no resource curse, but that positive trade shocks can be converted into long-term development if there is electoral competition and economic assets are not concentrated in a few hands.

Now, do the trade shocks of the beginning of the century matter to understand Brazil today? Our evidence shows that expenditures on education during our period in fact altered the development path of some states and changed their relative rankings compared to other states in a somewhat permanent way. For instance, the ranking of Brazilian states according to literacy rates has not changed much since 1920 or 1940. The states that ended up being the most educated 1940 are still the most educated today. While states that could not export much, had more entrenched colonial institutions, and had imperial elites slowing the diffusion of a new educational model, such as Pernambuco, Maranhão, Rio Grande do Norte, Piauí, Paraíba, Alagoas, and Goiás, ended up at the bottom of the ranking of literacy rates across states, and remained there for the rest of the twentieth century. Therefore, we think our paper suggests one explanation of the current levels of regional inequality in Brazil.

Finally, we have to qualify the relatively optimistic findings of the paper. Brazil had the fastest growth in literacy in the Americas between 1890 and 1940 and surpassed countries like Mexico, Venezuela, and Colombia. Yet Brazil started from an extremely low base and ended in what today would be considered a low level of literacy as well (around 40% of the population). Moreover, later studies about functional literacy and educational attainment have showed that in the year 2000 the percentage of the population who *does not* know how to read and write in Brazil is still 15%, putting that country far behind Mexico (8.8%), Colombia (8.4%), Chile (4.2%),

and Argentina (3.2%). [23] That is why we believe that the progress made in education during the first four decades of the twentieth century had mixed results in the long run.

[23] Data from Ferreira and Veloso (2005), p. 379 and Table 15.1.

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Appendix. Data Sources

Panel A. Sources for Education Indicators, 1872–1940

Variable	1872	1890	1900	1907	1920	1933	1940	Public/Private	Source
Literacy Rate	X	X	X		X		X		1872, 1890, 1900 and 1920 from Brazil (1923); 1940 from Brazil (1950)
Population, total, age brackets and national/foreigners	X	X	X		X		X		1872, 1890, 1900 and 1920 from Brazil (1923); 1940 from Brazil (1950)
Number of Primary Schools	X			X	X	X	X	Both	For 1872, from Brazil (1917a); 1907 from (1917b); 1920 from Brazil (1923); 1933 from Brazil (1936) and 1940 from Brazil (1946)
Enrollment in Primary Schools (TOTAL)	X			X	X	X	X	Both	For 1872 from Brazil (1940); 1907 from (1917b); 1920 from Brazil (1923); 1933 from Brazil (1936) and 1940 from Brazil (1946)
Primary Schools Teachers				X		X	X	Both	1907 from (1917b); 1920 from Brazil (1923); 1933 from Brazil (1936) and 1940 from Brazil (1946)
Teachers who attended a school of education ("Normal" Teachers)						X	X		Brazil (1946)
Graduation ("Conclusao")				X		X	X	Both	1907 from (1917b); 1920 from Brazil (1923); 1933 from Brazil (1936) and 1940 from Brazil (1946)

Panel B. Fiscal and Trade Data

Variable	Source:
Education Expenditure and Export Tax Revenue[24]	Willeman (1909) and Brazil (1926), data for the 1880s from Brazil (1887)
State Public Revenue[25]	For data before 1897, we use Brazil (1914). For data from 1897 to 1939, see AEB V (1939/40).
Commodity prices	Global Financial Data
Stock of Debt	Wileman (1909) has unbalanced data until 1908. For 1912 we take the information from Brazil (1917a). For 1922, we take the information from Brazil (1926) and finally for 1930 the source is Bouças (1932). We have also added data compiled for São

[24] We only have state expenditures in schooling for the periods: 1901-1907, 1914-1916, 1919-1921 and 1924-1926. Expenditures come from the state budgets and may differ from the actual amounts spent.

[25] The data is the budgeted and not the "actual" amounts spent. The data sources we have reported budgets for either 6 or 18 months, thus we had to annualize the amounts multiplying by 2 or 2/3 respectively. Finally, we completed some missing data using simple linear interpolation between the closest data points available.

	Paulo from Love (1980). We extrapolated between these data points in a way that allowed us to run a panel.
Exports and Imports	Data from 1902 (imports) and 1901 and 1902 (exports) from Brazil (1904); 1908-1912 comes from Brazil (1917a); Data from 1913-1927 and 1935-40 comes from Commerico Exterior do Brasil, several years.; Information from 1928-1934 is from Brazil (1938); Data for 1887, 1892 to 1897 and 1903-1907 is from Brazil (1908). Except for Minas Gerais[26] and the Federal District (Distrito Federal).[27] Data for Minas Gerais from Minas Gerais (1929)

[26] We have information only for states that had customs offices and a port (or a navigable river that connected it to the ocean). For this reason, we originally had no data for Góias (GO) and Minas Gerais (MG). Yet for Minas Gerais we have some reports of total exports, but not from which port they were shipped. Since we know that most of the exports were shipped from Rio de Janeiro (RJ), Santos (in São Paulo, SP), and in the 1920s through Espírito Santo (ES). For simplicity we assume that the exports of MG were exported through RJ and SP in equal proportions. Thus we subtract the exports from MG from those two other states. For the MG export data for 1927-1931, we assume that the MG average export share between 1923 and 1927 will prevail for the rest of the studied period and we proceed with the same methodology as explained above. In order to show that results of the estimations do not change, we also use the exports as reported by the federal publications (excluding MG). Unfortunately, data for imports for MG are not available. Therefore, all the estimations that include imports as a control exclude the observations from MG.

[27] The city of Rio de Janeiro was the capital of Brazil, known as Federal District (Distrito Federal or DF). Rio de Janeiro City is in the middle of what was Rio de Janeiro State, now Guanabara. Both the city and the state collected their own tax revenue, yet export taxes collected in the port of Rio de Janeiro accrued mostly to the State of Rio, while import taxes accrued to the Federal Government, as in other parts of the country. Moreover, the port of Rio de Janeiro, in the Federal District, served the states of Rio de Janeiro and Minas Gerais. Rio de Janeiro state had no other port until the 1920s (i.e. Angra dos Reis). Therefore, we cannot distinguish the exports made from the capital itself and Rio de Janeiro State (or Minas Gerais, see note above). We are confident, however, that most of the exports shipped from the Rio de Janeiro port were commodities produced in the state of Rio de Janeiro and not in the Federal District. Furthermore, we consider that the state of Rio de Janeiro benefited from the exports and economic activity of the port of the city of Rio de Janeiro and vice versa and for this reason we use the same level of international trade activity for both state and city.

Panel C. Data sources for variables that measure institutions, industrialization, and electoral participation

Variable	Definition	Source:
Capital invested	Total social capital in industrial companies	1920 Census
Dummy Good Commodity	If the state grew a "good" commodity is 1; otherwise 0. Good commodities include cacao, cattle, and cotton; bad commodities include Indians slave trade, mining, and sugar. We use Bruhn and Gallego's coding, but add Ceara as cotton and Piaui as sugar. Thus we code states as follows: AL=Sugar, AM=Cacao; BA=Sugar; CE=Cotton; ES=Sugar; GO=Mining; MA=Cotton; MG=Mining; MT=Cattle; PA=Cacao; PB=Sugar; PE=Sugar; PI=Sugar; PR=Mining; RJ=Sugar; RN=Cattle; RS=Cattle; SC=Cattle; SE=Sugar; SP=Indians.	Bruhn and Gallego (2007)
Immigrant Integration Index	Anti-immigration laws	Klein (1992) and Santos (2002)
	Voting restrictions for immigrants	Klein (1992) and Santos (2002)
	Estimates on return migration by nationality	Klein (1995) and Santos (2002)
	Language spoken	Skidmore (1999)
	European heritage	Neal (2002)
	Religion of country of origin	Neal (2002)
	Wages in the cotton industry	1920 Industrial Census
	Share of workers in management position	1920 Industrial Census
	Business ownership	1920 Industrial Census
Industrial Production and Number of Industrial Establishments; and Wage Premium	Industrial production in 1920 milreís and number of industrial establishments. Skill premium for 1940 is defined as the ratio of the average administrative wage to the average worker wage in 1940. Skill premium for 1920 is defined as the average wage of the food industry to the average wage of textile industry, as the former has more administrative workers than the latter.	1907, 1920 and 1940 Industrial Census
Mortality Rates	We use three different measures. The first one is an overall measure of mortality per 1,000 people from the population census of 1920 and 1940 (Brazil, 1923, 1950). The second is a measure of mortality from tropical diseases, which include yellow fever, "intermittent fever," Malaria or paludism, and Typhoid fever. The third measure also includes all sorts of gastrointestinal diseases, especially Cholera and Dysentheria. The latter two mortality rates are estimated over 1000 inhabitants and are for 1910.	Brazil (1913)
Population Density	Population/km^2	For population see Panel A; for state areas, see Wileman (1909)
Pre-colonial Native Population	Population per squared km at the time of colonization	Bruhn and Gallego (2007)
Size of Rural Establishments in 1920	Average number of hectares per rural establishment in 1920.	1920 Industrial Census
Slave Share in 1872	Percentage of the population that was slave in 1872	1872 Population Census
Voters in 1875, 1910 and 1934	Before 1891 the number of voters represent the number of registered voters, between 1891 and 1934 we have the data for the number of registered voters (*eleitores)* and we only have the number of actual votes for the 1910 election.	Brazil (1913) and ipeadata.com

Table 1. Literacy Rates in the Americas in Selected Years

	c. 1870		1890s		Early 1940s		% change by country	Differences in literacy vs. Brazil		Closing the literacy gap
	Ages	Rate (%)	Ages	Rate (%)	Ages	Rate (%)	1890s-1940s	1890s	1940s	
Argentina	6+	23.8	6+	45.6	*15+*	*82*	80	30.8	38	**No**
Brazil	**All**	**15.8**	**All**	**14.8**	**18+**	**44**	**197**			
Brazil adjusted*	**4+**	**18.5**	**4+**	**19.2**	**4+**	**40.5**	**111**			
Chile	7+	25.7	7+	30.3	10+	76	151	15.5	32	No
Costa Rica			7+	23.6	*15+*	*73*	209	8.8	29	No
Cuba			10+	40.5	10+	77.9	92	25.7	33.9	**No**
Guatemala			7+	11.3	10+	20	77	-3.5	-24	Ahead in 1890
Honduras			7+	15.2	*15+*	*43*	183	0.4	-1	**Yes**
Jamaica	5+	16.3	5+	32	10+	76.1	138	17.2	32.1	No
Mexico			*15+*	*24*	10+	48.4	102	9.2	4.4	**Yes**
Uruguay			10+	54	*15+*	*82*	52	39.2	38	**Yes**
The United States	10+	80	10+	86.7	14+	97.1	12	71.9	53.1	**Yes**

Source: Mariscal and Sokoloff (2000), Table 1. Figures in italics from Astorga, Berges, and Valpy FitzGerald (2003), Table A. 3. Most of their figures are interpolations. Data for the United States after 1900 from Goldin (2006), literacy rates are for all persons (whites and blacks) to make it comparable with Brazil. Data for Brazil from population census and AEB (1941-1945).

*Literacy rate calculated as number of literates over the population 4 years and older as a way to make comparisons over time in Brazil.

Table 2. Expenditures in Schooling, Literacy Rate , Enrollment and Schools

		Main Commodity	Expenditure in schooling per cap (avg. 1901-1926)	Expenditure in schooling per children (avg. 1901-1926)	Female Literacy Rate 1890	Male Literacy Rate 1890	Literacy Rate 1890	Female Literacy Rate 1940	Male Literacy Rate 1940	Literacy Rate 1940	Primary schools in 1889	Primary schools in 1933	% Change in Primary Schools	Students in 1889	Students in 1933	% Change in Students
Alagoas	AL	Sugar	0.5	2.4	10.6	17.0	13.7	19.0	20.4	19.6	209	560	168	6,928	32,913	375
Amazonas	AM	Rubber	3.2	15.0	8.5	22.5	16.2	33.0	40.5	36.9	122	926	659	3,546	24,100	580
Bahia	BA	Tobacco	0.4	2.0	6.2	11.1	8.7	20.2	27.7	23.8	671	1,624	142	22,131	86,876	293
Ceará	CE	Cattle	0.7	3.0	8.8	18.2	13.4	24.7	27.8	26.2	237	861	263	9,497	62,035	553
Espírito Santo	ES	Coffee	1.0	5.2	8.2	18.4	13.4	34.0	45.5	39.8	280	801	186	18,698	166,644	791
Distrito Federal	DF				43.8	57.9	51.7	74.2	82.7	78.5	105	784	647	2,582	44,783	1,634
Goiás	GO		0.2	1.2	5.4	16.6	10.9	17.9	27.5	22.8	95	391	312	2,708	22,956	748
Maranhão	MA	Cotton	0.5	2.5	9.0	17.4	13.2	19.2	23.3	21.3	170	636	274	6,545	34,117	421
Minas Gerais	MG	Coffee	0.8	10.2	6.5	14.1	10.4	29.0	37.5	33.2	1,757	3,628	106	46,997	396,769	744
Mato Grosso	MT	Rubber	1.8	4.4	10.6	22.9	16.9	35.7	44.9	40.6	51	302	492	1,830	20,888	1,041
Pará	PA	Rubber	2.0	6.9	12.3	31.8	22.2	36.0	46.7	41.3	336	999	197	11,904	65,745	452
Paraíba	PB	Cotton	0.5	8.8	8.4	16.9	12.5	19.3	22.4	20.8	92	710	672	2,531	51,317	1,928
Pernambuco	PE	Sugar	0.5	2.7	10.9	17.6	14.2	23.6	27.0	25.2	747	1,902	155	19,742	98,204	397
Piauí	PI	Cotton	0.2	2.8	5.1	14.8	9.9	15.5	22.8	19.1	84	181	115	2,129	15,999	651
Paraná	PR	Mate	1.4	1.1	11.4	25.7	18.8	36.6	49.1	43.0	213	1,037	387	6,968	69,140	892
Rio de Janeiro	RJ	Coffee	1.0	5.8	10.6	19.7	15.2	38.1	47.4	42.8	852	1,531	80	31,091	129,543	317
Rio Grande do Norte	RN	Cotton	0.5	3.1	10.8	20.1	15.4	26.6	27.7	27.1	159	430	170	5,443	34,847	540
Rio Grande do Sul	RS	Cattle	1.5	7.0	20.7	29.7	25.3	51.7	57.4	54.5	499	4,313	764	24,287	249,895	929
Santa Catarina	SC	Mate	0.8	4.4	15.8	23.5	19.6	45.1	53.2	49.2	174	1,733	896	7,508	100,861	1,243
Sergipe	SE	Sugar	0.9	5.0	7.9	12.6	10.2	25.8	28.8	27.2	206	448	117	3,750	22,291	494
São Paulo	SP	Coffee	3.6	19.4	9.2	18.8	14.1	46.2	59.0	52.8	1,098	4,910	347	21,989	488,646	2,122
Brazil			**1.2**	**6.0**	**10.4**	**19.1**	**14.8**	**34.4**	**42.6**	**38.5**	**8,157**	**28,707**	**252**	**258,804**	**2,218,569**	**757**

Table 3. Enrollment Rates in Elementary School in % (Children 5-14 years old)

	1872	1884	1889	1907	1933	1937	1940	Change in enrollment rate 1889	% Change in Enrollment rate 1940/1890
Acre					0.2		0.2		
Alagoas	5.2	6.9	5.4	7.0	13.2	16.2	18.0	12.8	243.5
Amazonas	12.6	13.2	10.0	8.5	23.2	32.2	31.9	19.2	152.5
Bahía	4.2	4.6	4.4	7.9	9.2	10.7	14.4	10.2	239.5
Ceará	5.0	4.2	4.2	7.3	13.0	15.4	17.7	12.7	251.4
Federal District	17.2	18.2	19.0	32.7	56.1	67.3	68.9	51.7	300.6
Espírito Santo	8.9	8.6	7.2	10.8	25.2	31.7	31.2	22.3	249.7
Goiás	5.1	4.7	4.4	7.8	12.1	13.3	16.4	11.2	218.0
Maranhão	6.0	4.3	5.7	8.6	12.2	9.5	17.0	11.0	184.3
Minas Gerais	5.6	6.4	5.7	11.5	23.4	26.5	25.2	19.6	351.6
Mato Grosso	8.5	9.1	7.9	15.1	22.8	26.9	25.5	17.0	199.4
Pará	7.8	13.5	13.5	16.6	27.9	39.9	43.1	35.3	455.2
Paraíba	3.3	2.3	2.0	6.3	16.0	21.5	20.8	17.5	538.5
Pernambuco	4.9	8.1	7.5	8.1	15.7	18.5	19.9	15.0	306.2
Piauí	4.0	3.9	2.9	7.1	8.0	14.9	17.3	13.3	328.5
Paraná	8.0	12.5	10.2	13.3	25.2	28.3	32.0	24.0	299.4
Rio de Janeiro	9.6	11.7	14.4	9.7	29.1	32.9	36.5	26.9	280.2
Rio Grande do Norte	6.2	9.2	7.7	9.4	20.6	23.9	23.3	17.1	274.2
Rio Grande do Sul	10.3	9.1	9.8	21.3	33.2	35.8	42.7	32.4	314.0
Santa Catarina	8.0	9.5	10.0	20.0	37.3	43.2	41.2	33.2	414.8
Sergipe	9.2	5.8	4.9	10.6	17.4	19.6	25.6	16.4	177.4
São Paulo	5.6	6.6	6.3	13.8	31.6	40.7	41.4	35.9	642.2
Standard deviation*	**2.4**	**3.3**	**3.3**	**4.4**	**8.2**	**10.3**	**9.6**	**8.4**	**124.4**
Coefficient of variation*	**39.9**	**49.4**	**47.0**	**36.4**	**35.3**	**37.0**	**32.1**	**35.6**	**32.2**
Brazil (avg)	**6.1**	**6.7**	**7.0**	**12.0**	**23.3**	**27.9**	**29.8**	**23.7**	**385.8**

Source: Anuario Estatistico do Brasil, several volumes; Estatistica da Instrucao (1917) and Population Censuses

Notes: Population in school age was computed using simple lineal interpolations between the census years (i.e., 1872, 1890, 1920, 1940).

* Excludes Distrito Federal

Table 4. Number of schools per thousand children between 5 and 14 years of age

	1872	1884	1889	1907	1933	1937	1940
Acre							5.20
Alagoas	2.16	1.91	1.62	1.47	2.25	2.77	2.61
Amazonas	4.46	4.13	3.43	3.80	8.90	5.24	5.72
Bahía	0.81	1.50	1.34	1.69	1.72	1.69	1.80
Ceará	1.10	1.03	1.04	1.67	1.80	2.34	2.91
Federal District	3.55	3.03	2.84	2.77	2.70	3.99	3.04
Espírito Santo	4.53	3.29	2.93	3.06	4.40	5.48	4.14
Goiás	1.73	1.65	1.56	2.03	2.06	2.33	2.24
Maranhão	1.55	1.63	1.49	1.60	2.28	1.38	2.85
Minas Gerais	1.93	1.47	2.15	2.08	2.14	3.18	2.74
Mato Grosso	2.20	2.52	2.20	3.20	3.30	4.10	3.13
Pará	2.50	3.81	3.80	2.74	4.23	5.79	4.70
Paraíba	1.04	0.81	0.74	1.35	2.22	2.97	2.95
Pernambuco	2.16	3.18	2.85	1.73	3.04	3.39	3.36
Piauí	1.66	1.20	1.14	1.67	0.91	2.14	2.06
Paraná	3.60	4.74	3.11	2.97	3.78	4.61	4.72
Rio de Janeiro	3.97	3.23	3.95	1.97	3.44	3.61	3.79
Rio Grande do Norte	1.94	2.26	2.26	1.91	2.55	3.22	3.25
Rio Grande do Sul	3.56	1.91	2.01	4.36	5.73	6.94	6.04
Santa Catarina	2.87	2.38	2.31	4.99	6.41	7.88	6.62
Sergipe	3.27	3.27	2.69	3.36	3.49	3.56	5.02
São Paulo	2.05	3.43	3.15	2.72	3.18	4.18	3.96
BRAZIL	**2.00**	**2.16**	**2.21**	**2.35**	**3.02**	**3.72**	**3.53**

Table 5. Expenditures on Education as a % of total state expenditures, 1901-1919

	1901	1905	1915	1919	Average 1901-1919	Standard Deviation	Expenditure pc (milreis)
Bahia	9.5	5.2	3.1	3.0	6.4	3.5	6.8
Pernambuco		7.5	7.2	6.8	7.1	0.9	7.3
Góias	7.4	9.8	4.1	6.4	7.6	2.5	3.1
Espírito Santo	6.0	9.5	14.4	11.5	9.0	3.5	13.0
Piauí	8.7	10.0	5.7	10.0	9.0	2.3	2.7
Rio Grande do Norte	10.8	8.8	8.7	6.5	9.2	1.8	5.9
Amazonas	7.7	6.6	7.8	10.0	9.5	3.9	41.0
Maranhão		11.8	10.2	11.4	10.2	2.4	4.6
Pará		14.4	11.0	10.5	10.8	3.2	17.0
Rio de Janeiro	8.6	13.7	14.7	11.8	11.4	3.0	9.4
Mato Groso		8.2	12.5	11.2	11.8	3.5	15.7
State average	13.4	11.3	12.2	11.7	11.8	1.2	10.3
Paraíba	12.7	11.8	13.3	13.9	12.4	2.0	4.3
Santa Catarina	14.9	10.5	16.1	12.3	12.8	2.8	6.4
Alagoas	18.5	10.8	15.0	12.5	13.4	3.8	3.8
Paraná	18.0	8.5	15.9	16.8	13.6	3.5	11.3
Sergipe	20.0	11.7	16.1	10.8	14.1	4.2	7.1
Minas Gerais	14.0	12.4	19.1	14.9	15.2	2.5	5.6
Rio Grande do Sul	22.7	21.8	15.3	14.8	15.4	6.7	12.1
São Paulo	17.1	13.1	17.9	18.0	15.6	3.9	24.6
Ceará	18.3	20.4	16.6	21.2	19.0	6.9	3.7
Mean	**13.4**	**11.3**	**12.2**	**11.7**	**11.7**	**3.2**	**10.3**

Table 6. Share of enrollment in Schools by state (as a % of total enrollment), 1907-1940

	State Schools			Local Schools			Private Schools			Federal Schools		
	1907	1933	1940	1907	1933	1940	1907	1933	1940	1907	1933	1940
Acre	n.a.	47.6	34.4	n.a.	46.9	58.3	n.a.	5.5	7.3	n.a.	0.0	0.0
Alagoas	70.2	69.3	52.0	3.4	6.5	21.9	25.2	24.2	26.1	1.2	0.0	0.0
Amazonas	66.5	83.4	74.3	5.8	n.a.	10.7	27.8	16.6	15.0	0.0	0.0	0.0
Bahia	54.5	86.4	82.8	22.0	n.a.	4.9	21.8	13.6	12.1	1.7	0.0	0.1
Ceará	65.2	88.8	66.8	3.2	n.a.	22.1	30.5	11.2	11.0	1.0	0.0	0.0
Distrito Federal	0.0	0.0	0.0	63.0	73.2	57.9	29.1	25.6	41.2	7.8	1.2	0.8
Espírito Santo	48.3	86.8	84.7	26.0	5.0	9.5	25.6	8.2	5.8	0.0	0.0	0.0
Goiás	42.7	68.7	49.4	31.8	22.8	31.5	25.5	8.6	18.3	0.0	0.0	0.8
Maranhão	59.3	57.7	32.5	18.1	23.8	46.7	22.0	18.4	20.8	0.7	0.0	0.0
Mato Grosso	72.6	62.4	64.2	0.9	9.0	10.7	25.8	28.7	25.1	0.7	0.0	0.0
Minas Gerais	70.2	79.1	55.1	15.1	6.6	37.6	14.7	14.3	7.3	0.0	0.0	0.0
Pará	56.9	77.1	81.4	27.2	n.a.	0.0	15.8	22.9	18.6	0.0	0.0	0.0
Paraíba	48.7	84.8	70.0	20.1	n.a.	0.0	29.5	15.2	30.0	1.7	0.0	0.0
Paraná	67.4	85.2	82.4	3.7	1.6	6.6	27.9	13.2	11.0	1.1	0.0	0.0
Pernambuco	23.6	34.3	25.6	50.8	38.4	39.8	22.1	27.1	34.6	3.4	0.2	0.0
Piauí	59.0	82.2	75.7	4.4	1.9	9.2	36.5	15.8	15.2	0.0	0.0	0.0
Rio de Janeiro	69.1	69.4	60.0	5.2	18.3	28.2	25.7	12.3	11.8	0.0	0.0	0.0
Rio Grande do Norte	42.7	71.8	66.5	24.9	n.a.	8.5	31.9	28.2	24.8	0.5	0.0	0.2
Rio Grande do Sul	60.5	36.0	31.5	5.9	35.4	23.2	31.7	27.9	44.0	1.9	0.7	1.3
Santa Catarina	32.7	55.2	59.8	18.7	17.9	32.5	47.8	26.8	7.7	0.8	0.0	0.0
São Paulo	64.1	81.8	76.5	11.1	4.3	9.1	24.2	13.9	14.4	0.6	0.0	0.0
Sergipe	69.1	66.8	57.4	3.4	11.1	17.8	25.1	22.1	24.8	2.3	0.0	0.0
TOTAL	**53.7**	**65.3**	**57.1**	**19.9**	**16.3**	**22.7**	**24.8**	**18.2**	**20.0**	**1.6**	**0.2**	**0.2**

Table 7. Pupils by teacher, 1907-1940

	Pupils by teacher			Pupils by teacher in state schools		
	1907	1933	1940	1907	1933	1940
Acre			29.3		35.3	29.2
Alagoas	36.7	44.4	41.7	42.1	49.4	41.2
Amazonas	16.2	20.2	36.8	16.3	19.2	38.3
Bahia	30.1	32.9	51.6	44.8	37.7	58.3
Ceará	30.6	42.1	35.7	38.7	46.2	37.0
Distrito Federal	22.5	33.6	37.0			
Espírito Santo	30.7	41.2	41.6	34.6	43.3	43.1
Goiás	28.3	36.7	35.3	27.9	41.6	46.6
Maranhão	38.2	37.0	42.2	44.7	39.5	44.8
Minas Gerais	39.0	40.1	37.1	59.1	40.6	35.7
Mato Grosso	27.3	33.6	39.2	42.9	34.1	38.6
Pará	27.4	42.1	52.6	34.4	45.1	52.6
Paraíba	32.7	51.1	47.3	45.6	57.8	52.5
Pernambuco	30.8	40.2	39.0	44.7	42.4	40.6
Piauí	32.3	40.9	48.8	45.1	45.8	53.5
Paraná	33.3	35.9	33.6	40.5	37.0	33.3
Rio de Janeiro	31.0	45.8	48.3	47.1	45.0	47.2
Rio Grande do Norte	40.1	54.2	49.3	48.7	56.7	51.2
Rio Grande do Sul	36.8	38.1	37.7	49.6	41.0	34.4
Santa Catarina	33.2	42.9	44.5	42.6	49.7	45.5
Sergipe	27.1	38.8	39.4	32.5	41.0	43.2
São Paulo	27.4	37.3	42.9	31.7	39.2	44.0
TOTAL	31.0	38.6	40.8	42.2	40.9	42.3

Table 8. State Expenditures on Education Per Capita Before and During the Republic, 1875-1925

		1875-1884 (average)		1901-1925 (average)		
	Main commodity exported	Expenditure on education per capita (1913 milreis)	Expenditures on education /total expenditure	Expenditure on education per capita (1913 milreis)	Expenditures on education /total expenditure	Growth in real expenditures per capita
Minas Gerais	Coffee	0.4	28%	2.4	15%	448%
São Paulo	Coffee	0.7	14%	3.6	16%	441%
Espírito Santo	Coffee	1.2	22%	1.0	9%	-14%
Rio de Janeiro	Coffee	1.6	19%	1.2	11%	-24%
Amazonas	Rubber	1.8	12%	3.2	9%	80%
Mato Grosso	Rubber	0.9	23%	1.7	12%	76%
Pará	Rubber	2.4	25%	2.1	11%	-13%
Paraná	Mate	0.9	20%	1.4	14%	54%
Santa Catarina	Mate	0.6	27%	0.8	13%	30%
Ceará	Cattle	0.4	23%	0.7	19%	76%
Rio Grande do Sul	Cattle	1.1	19%	1.8	15%	67%
Sergipe	Sugar	0.7	19%	0.9	14%	24%
Alagoas	Sugar	0.5	19%	0.5	13%	-3%
Pernambuco	Sugar	1.0	20%	0.5	7%	-46%
Paraíba	Cotton	0.4	18%	0.5	12%	31%
Rio Grande do Norte	Cotton	0.5	27%	0.5	9%	-2%
Piauí	Cotton	0.3	16%	0.2	9%	-14%
Maranhão	Cotton	0.9	32%	0.5	10%	-46%
Bahia	Tobacco	0.5	15%	0.4	6%	-15%
Goiás		0.4	21%	0.2	8%	-37%
Brazil		**0.7**	**19%**	**1.3**	**11%**	**79%**

Table 9. Expenditure on education per capita at State Level. 1901-1926. The dependent variable is the logarithm of the expenditure per capita in schooling. Regressions test the hypothesis that revenues per capita derived by exports explain the capacity of the states to provide schooling. A positive coefficient on export tax revenue per capita support our hypothesis that states with endowments that yielded higher export revenues were able to spend more on education. Specifications 6 through 10 include state-specific trends.Variables are in logarithms, so the coefficient is an elasticity. Robust cluster standard errors shown in parenthesis. Year and state dummies included in all specifications. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Fixed effects and year dummies					Fixed effects, year dummies, and state-specific trends					
	Log (Schooling pc)	Log (Schooling pc)	Log (Schooling pc)	Log (Schooling pc) no coffee	Log (Schooling pc) no rubber	Log (Schooling pc)	Log (Schooling pc)	Log (Schooling pc)	Log (Schooling pc) no coffee	Log (Schooling pc) no rubber	Log (Schooling pc) no rubber & no coffee
Log (Exports Revenue pc)	**0.344*** **	**0.268*** **	**0.268*** **	**0.272*** **	**0.151** **	**0.184** **	**0.141***	**0.129***	**0.154***	**0.115***	**0.136**
	(0.10)	**(0.08)**	**(0.07)**	**(0.07)**	**(0.06)**	**-0.088**	**-0.072**	**-0.067**	**-0.078**	**-0.063**	**(0.080)**
Log (Import pc)		0.248***	0.160*	0.188*	0.057		0.120*	0.076	0.129	0.053	0.097
		(0.08)	(0.08)	(0.09)	(0.06)		-0.068	-0.062	-0.081	-0.058	(0.072)
Log (Debt pc)		0.148	0.188	0.245	0.043		-0.02	-0.083	-0.068	-0.096	-0.077
		(0.16)	(0.28)	(0.30)	(0.29)		-0.061	-0.066	-0.065	-0.067	(0.064)
Log (Population Density)		-0.014	-0.045	-0.035			0.283	0.602	0.229	0.525	0.129
		(0.07)	(0.06)	(0.05)			-0.484	-0.615	-0.588	-0.598	(0.549)
Constant	-4.595***	-5.500***	-5.571***	-5.617***	-6.085***	-5.559***	-5.960***	-5.490***	-5.767***	-5.612***	-5.904***
	(0.59)	(0.56)	(0.72)	(0.79)	(0.78)	-0.524	-0.624	-0.952	-0.945	-0.828	(0.682)
Export commodity mix	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y
State fixed FXs	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-specific trends	N	N	N	N	N	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Observations	292	255	255	214	230	292	255	255	214	228	187
R-squared	0.89	0.89	0.90	0.89	0.90	0.93	0.93	0.94	0.93	0.93	0.917

Table 10. First Stage. Export Tax Revenue per capita. The instrument is the simulated prices to explain the export tax receipts of the states. We expect that favorable commodity prices in international markets affected positively the exports and furthermore the export tax revenue collected by state governments. The hypothesis is that the coeffcient is positive. Variables are at logarithms and they should be interpreted as elasticities. Specifications include state and year fixed effects. Robust clustered standard errors shown in parenthesis. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

	(1)	(2)	(3)	(4)
	Log (Export Tax Revenue pc)	Log (Export Tax Revenue pc)	Log (Export Tax Revenue pc) no SP	Log (Export Tax Revenue pc) no coffee
Log (Simulated Prices)	0.565***	0.588**	0.608**	0.693**
	(0.12)	(0.23)	(0.26)	(0.26)
Log (Import pc)		0.186	0.248	0.285
		(0.15)	(0.17)	(0.21)
Log (Population Density)		-0.187	-1.067	-1.138
		(0.25)	(0.67)	(0.69)
Log (Debt pc)		0.034	0.062	0.074
		(0.12)	(0.11)	(0.12)
Constant	-8.518***	-8.453***	-6.827***	-7.037***
	(0.56)	(1.41)	(1.81)	(1.79)
Commodity Shares	No	No	Yes	Yes
Observations	274	257	242	216
R-squared	0.784	0.813	0.83	0.827

Table 11. Second Stage. Instrument: Simulated Prices, Endogenous Variable: Exports Tax Revenue pc. The dependent variable is the logarithm of the expenditure per capita in different functions. Regressions test the hypothesis that revenues per capita derived by exports (instrumented by the simulated export tax revenue) explain the capacity of the states to provide different public goods A positive coefficient on export tax revenue per capita and a negative one in the coupon spread support our hypothesis that better endowed states were able to provide more public goods. Cluster robust standard errors shown in parenthesis. State and year dummies are not shown. Coefficients marked with: *** ndicates significant at 1%, ** at 5% and * at 10%

	(1)	(2)	(3)	(4)	(5)
	Log (Schooling pc)	Log (Schooling pc)	Log (Schooling pc) No coffee	Log (Schooling pc) No PA	Log (Schooling pc) No AM
Log (Exports Revenue pc)	0.632***	0.357***	0.368***	0.332**	0.456*
	(0.17)	(0.10)	(0.11)	(0.12)	(0.24)
Log (Import pc)		0.131	0.15	0.088	0.13
		(0.08)	(0.10)	(0.07)	(0.08)
Log (Debt pc)		-0.046	-0.038	-0.051	(0.04)
		(0.06)	(0.05)	(0.06)	(0.05)
Log (Population Density)		0.261	0.316	0.246	0.41
		(0.24)	(0.27)	(0.25)	(0.41)
Constant	-3.042***	-5.161***	-5.366***	-5.376***	-4.831***
	(0.93)	(0.81)	(0.90)	(0.95)	(1.04)
Commodity Shares	No	Yes	Yes	Yes	Yes
Observations	272	255	214	243	240
R-squared	0.839	0.899	0.891	0.909	0.875

Table 12. Cross Section. The dependent variables are Change in Literacy Rate between 1940 and 1890 (1-6), Percentual change in the number of primary schools (7-12) and the % change of students enrolled in primary schools (13-18). The independent variable is the average expenditure per capita in schooling between 1901- 1926. We want to test the hypothesis that large expenditure on education had effects on education outcomes such as literacy, schools and students. Robust errors in parenthesis. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

	(1) Change in Literacy Rate 1940-1890	(2) Change in Literacy Rate 1940-1891	(3) Change in Literacy Rate 1940-1892	(4) Change in Literacy Rate 1940-1893	(5) Change in Literacy Rate 1940-1894	(6) Change in Literacy Rate 1940-1895	(7) % change in primary schools 1940-1890	(8) % change in primary schools 1940-1891	(9) % change in primary schools 1940-1892	(10) % change in primary schools 1940-1893	(11) % change in primary schools 1940-1894	(12) % change in primary schools 1940-1895	(13) % Change in Students 1940-1890	(14) % Change in Students 1940-1891	(15) % Change in Students 1940-1892	(16) % Change in Students 1940-1893	(17) % Change in Students 1940-1894	(18) % Change in Students 1940-1895
Average expenditure per capita on schooling	0.065***	0.057**	0.056**	0.076***	0.060***	0.072***	0.822*	1.002***	1.000***	1.551*	1.318	1.672*	2.192	2.299	2.301	6.106***	6.088***	6.594***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.46)	(0.31)	(0.32)	(0.77)	(0.89)	(0.76)	(1.69)	(1.74)	(1.80)	(0.52)	(0.51)	(0.62)
Imports pc						0.000**						0.011						0.012
						0.00						(0.01)						-0.01
Population					0.000***	0					0	0					0	0
					0	0					0	0					0	0
% Change of private schools enrollment			-0.233**	-0.254***	-0.299***	-0.291***			-2.377	-2.985	-2.946	-2.363			-4.471	-7.922	-7.979	-7.447
			(0.09)	(0.08)	(0.07)	(0.08)			(7.35)	(7.26)	(7.71)	(8.33)			-7.803	-5.79	-6.611	-7.191
Exports per capita				0	0	-0.001				-0.012	-0.006	-0.012				-0.085***	-0.084***	-0.096***
				0.00	0.00	0.00				(0.01)	(0.02)	(0.02)				-0.012	-0.014	-0.021
Literacy rate in 1890		0.455	0.552	0.524	0.855**	0.723*												
		(0.38)	(0.39)	(0.35)	(0.32)	(0.34)												
Primary schools in 1889								-0.002***	-0.002***	-0.002**	-0.005	-0.009						
								(0.00)	(0.00)	(0.00)	(0.00)	(0.01)						
Number of students enrolled in 1889														0	0	0	0	0
														0.00	0.00	0.00	0.00	0.00
Enrollment rate in 1889																		
Constant	0.114***	0.057	0.025	0.024	-0.051	-0.036	2.338***	3.011***	2.790***	2.633**	2.521**	2.700**	5.319**	6.123***	5.688**	5.200*	5.143	5.526
	(0.02)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.76)	(0.83)	(0.88)	(1.07)	(1.05)	(1.05)	(1.87)	(2.04)	(2.56)	(2.62)	(3.39)	(3.77)
Observations	20	20	20	19	19	18	20	20	20	19	19	18	20	20	20	19	19	18
R-squared	0.46	0.498	0.6	0.62	0.742	0.793	0.098	0.24	0.254	0.286	0.319	0.328	0.168	0.202	0.214	0.564	0.564	0.574

TAble 13. Panel Data. Dependent variables are the logarithm of literacy rate, the logarithm of enrollment rate (Total Enrollment/Children 5-14) at primary schools and the logarithm of primary schools at state levelIndependent variable is logarithm of Simulated Prices. We test the hypothesis that favorable fluctuations in the international price of commodities increased the expenditure on schooling, which was reflected in higher education outcomes as reflected by the dependent variables. The expected sign is positive and it is an elasticity. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

VARIABLES	Log(Literacy Rate)	Log (schools)	Log (Enrollment Rate)	Controls
Coefficient of Log(simulated Prices)	0.184*	0.647***	0.329***	None
Coefficient of Log(simulated Prices)	0.330***	0.560***	0.429***	Fixed Effects
Coefficient of Log(simulated Prices)	0.311***	0.619***	0.462***	FE, Log (Imports pc), Log (Exports pc)
Coefficient of Log(simulated Prices)	0.211**	0.758***	0.541***	FE, Log (Imports pc), Log (Exports pc), Time Dummy
Coefficient of Log(simulated Prices)	-0.144	-0.101	-0.038	FE, Log (Imports pc), Log (Exports pc), Time Dummy, Log (population)

Table 14. Public Goods Expenditures per capita at State Level. 1901-1926. Alternative Hipotheses. The dependent variable is the logarithm of expenditure per capita in schooling Regressions test the hypothesis that public revenues per capita from export taxes explain the capacity of the states to provide different public goods. A positive coefficient on export tax revenue per capita support our hypothesis that better endowed states were able to provide more education. Moreover, an interaction term of export tax revenue with the share of slaves in 1872, the mortality rate (overall, tropical and tropical and gastrointestinales) in states´capitals, the average size of rural establishments in 1920, concentration of rural ownership in 1920 and population density at colonization time is included in order to test whether colonial institutions mattered to explain the pattern in public expenditure. Monetary variables are in 1913 reis. Robust cluster standard errors shown in parenthesis. Year and state dummies included in all specifications. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

VARIABLES	(1) Log (Schooling pc)	(2) Log (Schooling pc)	(3) Log (Schooling pc)	(4) Log (Schooling pc)	(5) Log (Schooling pc)	(6) Log (Schooling pc)	(7) Log (Schooling pc)
Log (Exports Revenue pc)	1.085***	0.449**	1.222***	1.451***	0.504***	0.359**	174.331**
	(0.21)	(0.18)	(0.23)	(0.29)	(0.16)	(0.13)	(73.35)
Log (Exports Revenue pc*Slave share in 1872)	-0.816***	-0.165	-0.758**	-0.709**	0.277	0.458*	81.959**
	(0.19)	(0.16)	(0.26)	(0.25)	(0.25)	(0.22)	(34.91)
Log (Exports Revenue pc*Mortality rate in 1910)		-0.019			-0.259***	-0.414***	-20.738**
		(0.15)			(0.08)	(0.08)	(8.86)
Log (Exports Revenue pc*Mortality Tropical Diseases in 1910)			-0.167**				
			(0.06)				
Log (Exports Revenue pc*Mortality rate Tropical and gastrointestinales diseases in 1910)				-0.445**			
				(0.16)			
Log (Exports Revenue pc*Native population pre colonial)					-0.255	-0.275	-151.113**
					(0.21)	(0.21)	(63.89)
Log (Exports Revenue pc*Dummy Good Commodity)						16.431***	16.400***
						(5.19)	(5.24)
Log (Exports Revenue pc*Average Size of Rural Establishment in 1920)							-84.309**
							(35.49)
Log (Debt pc)	-0.024	-0.031	0.077	0.077	-0.031	-0.031	-0.032
	(0.07)	(0.08)	(0.17)	(0.17)	(0.08)	(0.08)	(0.08)
Log (Import pc)	0.233**	0.199*	0.301**	0.301**	0.199*	0.14	0.139
	(0.09)	(0.09)	(0.13)	(0.13)	(0.09)	(0.10)	(0.10)
Constant	-7.300***	-5.502***	-8.150***	-7.150***	-3.479***	-3.209***	827.865**
	(0.79)	(1.06)	(1.38)	(1.32)	(1.05)	(1.03)	(352.74)
Observations	255	214	140	140	214	214	214
R-squared	0.887	0.865	0.883	0.883	0.865	0.875	0.876

Note. The average and standard deviation (in parenthesis) for each institutional variable is as follows: slave share in 1872=0.05(0.07); mortality rate in 1910 (deaths per 1000 inhabitants)=30.4(11.5); mortality rates due to tropical diseases=2.93(3.95); mortality rate due to tropical and gastrointestinal diseases =7.25(3.9); precolonial native population (inhabitants per km2)= 3.1 (2.6); dummy of good commodity in the colony= 0.45(0.51), and average size of rural establishment in 1920(has)= 630(1246)

Table 15. Ranking of States by Enrollment Rates In the Long Run

Panel A. Ranking of States by Enrollment Rates

	1872		1890		1940		2007	
	Literacy rate	Ranking	Literacy rate	Ranking	Literacy rate	Ranking	Literacy rate	Ranking
States that moved up the ranking over time								
SP	18.8	10	16.6	10	52.1	2	95.4	3
SC	16.5	11	23.3	3	49.1	3	95.6	2
GO	16.2	12	12.6	16	22.8	16	91.2	8
AM	14.1	15	19.0	6	36.6	9	92.0	6
ES	13.1	17	16.0	13	39.8	8	91.5	7
MG	11.2	20	12.2	17	33.0	10	91.1	9
RJ	19.1	9	17.8	8	42.5	5	95.7	1
States that did not move significantly from their ranking in 1872a								
PR	28.9	1	22.5	4	42.9	4	93.4	5
RS	22.5	3	30.3	1	54.4	1	95.0	4
SE	13.4	16	11.6	19	27.2	11	83.2	12
CE	13.0	18	16.3	11	26.2	13	80.8	15
PB	12.9	19	14.9	15	20.8	18	76.5	18
States that moved down the ranking over time								
PA	26.7	2	26.0	2	41.1	6	88.3	11
MA	22.1	4	15.4	14	21.2	17	78.5	17
MT	20.5	5	19.4	5	40.5	7	89.9	10
BA	20.3	6	10.1	20	23.7	15	81.5	13
PE	19.6	7	16.8	9	25.1	14	81.5	14
RN	19.1	8	18.3	7	27.1	12	80.4	16
PI	15.0	13	11.8	18	19.0	20	76.5	19
AL	14.3	14	16.2	12	19.5	19	74.8	20

Panel B Correlation of Literacy Rates by Stateb

	1872	1890	1900	1920	1940	1950	1970	1980	1991
1890	0.8215*	1							
1900	0.6735*	0.8666*	1						
1920	0.7432*	0.9107*	0.9256*	1					
1940	0.6555*	0.8372*	0.8631*	0.9731*	1				
1950	0.6070*	0.7888*	0.8055*	0.9427*	0.9895*	1			
1970	0.3969	0.5539*	0.6529*	0.7840*	0.8719*	0.9127*	1		
1980	0.3914	0.5381	0.6447*	0.7718*	0.8592*	0.8984*	0.9922*	1	
1991	0.3545	0.4844	0.6069*	0.7382*	0.8301*	0.8732*	0.9792*	0.9925*	1
2007	0.3295	0.4735	0.6504*	0.7384*	0.8218*	0.8550*	0.9684*	0.9801*	0.9839*

Notes:a) This group shows states that did not move more than five places in the overall ranking between 1872 and 2007. b) These correlations include all states except the Federal District. Stars (*) denote 1% significance.

Table 16. **Education Expenditures per capita at State Level. 1901-1926. Alternative Hipotheses.** The dependent variable is the state expenditure per capita in schooling. Regressions test the hypothesis that revenues per capita derived by exports explain the capacity of the states to provide different public goods. A positive coefficient on export tax revenue per capita support our hypothesis that better endowed states were able to provide more public goods. Moreover, an interaction term of export tax revenue with industrialization, population, voters and foreigners. All these variables were normalized with mean 0 and standard deviation 1. Monetary variables are in 1913 reis. Robust cluster standard errors shown in parenthesis. Debt per capita, population density, year and state dummies included in all specifications. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

	1	2	3	4	5	6	7
	exp. on educ per capita	exp. on educ per capita	exp. on educ per capita	exp. on educ per capita	exp. on educ per capita	exp. on educ per capita	exp. on educ per capita
Export Tax Revenue pc	0.108***	0.069***	0.035**	0.054***	0.061***	0.116***	0.097***
	(0.02)	(0.015)	(0.02)	(0.02)	(0.02)	(0.032)	(0.032)
ETRpc*foreigners1890	-0.073**						
	(0.03)						
ETRpc*foreigners1920		-0.048					
		(0.031)					
ETRpc*industrias1907			-0.101**				
			(0.05)				
ETRpc*industrial production1907				-0.037*			
				(0.02)			
ETRpc*industrial production growth 1940/1907					-0.023***		
					(0.00)		
ETRpc*skillpremium1920						-0.036*	
						(0.019)	
ETRpc*skillpremium1940							-0.048
							(0.036)
Constant	0.001***	0.001***	0.002***	0.001***	0.001***	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	285	285	285	285	285	272	217
R-squared	0.935	0.922	0.926	0.917	0.918	0.929	0.916

Table 17. Immigration and Investments in Public Education

These OLS regressions examine the correlation between the effect of the stock of immigrants and an index of integration and different measures of investment in education. The sample size is restricted because we take the average of our variables and use the data on immigrants at the state level in 1920. Coefficients are marked *, **, and *** for 10%, 5%, 1% significance levels, respectively. Robust standard errors in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Exp. on education per capita	Exp. on education per capita	Exp. on education per capita	Exp. on education per capita	Pupil-Teacher Ratio	Pupil-Teacher Ratio	Pupil-Teacher Ratio	Pupil-Teacher Ratio	Number of State Schools	Number of State Schools	Number of State Schools	Number of State Schools
ln(immigrants)	0.218**	0.188**			-0.005	-0.059			0.147	0.184		
	-0.08	-0.09			-0.42	-0.43			-0.14	-0.14		
Index (Integration Immigrants)			0.490***	0.504***			-0.137	-0.116			0.327	0.019
			-0.07	-0.02			-0.31	-0.29			-0.13	-0.15
Export Revenues pc	0.057***	0.044***	0.067***	0.049***	-0.284***	-0.308***	-0.283***	-0.310***	0.037	0.054***	0.046**	0.063***
	-0.018	(<0.01)	-0.02	(<0.01)	-0.05	-0.04	-0.05	-0.05	-0.026	-0.01	-0.02	-0.01
Population Density		0.002***		0.003***		0.004**		0.004***		-0.003***		-0.002***
		(<0.01)		(<0.01)		(<0.01)		(<0.01)		(<0.01)		(<0.01)
Constant	-1.443	-1.116	0.475	0.556	38.922	39.5	38.862	39.984	1.098	0.693	2.361	2.282
	-0.67	-0.71	-0.15	-0.06	-4.39	-4.54	-1.14	-1.14	-1.09	-1.12	-0.36	-0.34
Observations	21	21	21	21	21	21	21	21	21	21	21	21
R-squared	0.81	0.91	0.84	0.97	0.6	0.62	0.6	0.62	0.33	0.48	0.29	0.41

Note: The index of integration of immigrants is normalized (mean=0 and std. dev=1) and weights the following variables: a) Acculturation [Language: score (3=Portuguese; 2=European language; 1=other) European heritage: indicator if immigrant's background is European; Religion: indicator if Catholic religion]; and, b) Adjustment and integration of the immigrants [wage with respect to natives in the cotton industry (industry census 1920); share of workers in management position (industry census 1920); business ownership (industry census 1920); share of immigrants who stay in the country (estimates available on return migration by nationality from Klein (1995) and dos Santos (2002))]. The index is a weighted average of the different components with weights being the shares of immigrants by nationality.

Table 18A: Immigration, Industrialization and Expenditures on Schooling, 1907-1920. These OLS regressions estimate the effect of the share of foreigners and capital invested in the industrial sector on the expenditure on education in primary schools at the state level, between 1907 and 1920(controlling for population density). capital invested and foreigners. The sample size is restricted because we use the education census years (1907 and 1920) and capital invested from the 1920 industrial census. Year dummies are included in the specification. Coefficients are marked *, **, and *** for 10%, 5%, 1% significance levels, respectively. Robust standard errors in parenthesis (clustered at state level).

	1	2	3	4	5	6
VARIABLES	Exp. on education per capita	Exp. on education per capita	Exp. on education per capita	Exp. on education per capita	Exp. on education per capita	Exp. on education per capita
Ln(num. foreigners)	0.336**	-0.056	0.022			
	(0.146)	(0.08)	(0.06)			
Ln(capital invested)				-0.158	-0.126	-0.088
				(0.15)	(0.08)	(0.06)
Ln(pop density)			0.003***			0.003**
			<0.001			(<0.001)
Ln(% immigrants)		0.148***	0.080**		0.134***	
		(0.05)	(0.03)		(0.04)	
Constant	-1.815	1.222	0.592	2.870	1.990	1.643
	(1.21)	(0.72)	(0.53)	(1.62)	(0.88)	(0.72)
Observations	42	42	42	42	42	42
R-squared	0.25	0.49	0.62	0.04	0.51	0.63

Table 18B Changes in Technology Imports across Industries, 1900–1939

	Machinery for the Generation of Energy	**Electric Engines**	**Textile Machinery**	**Machinery for Woodwork**
Change 1900-1919	+26.68%	n.a.	+11.22%	n.a.
Change 1920-1939	+0.13%	+139.86%	+285.37%	+147.20%
Change 1900-1939	+70.49%	n.a.	+300.36%	n.a.

Note: n.a.= not available (only from 1913 onwards for electric equipment and from 1908 onwards for wood machinery)
Source: Suzigan W. (2000), "Industria Brasileira: Origem e Desenvolvimento", pp.372-383

Table 19. Dependent variable are the logarithm of number of voters and the logarithm of Voters/Population for 1875, 1910 and 1934. The independent variable is the logarithm of Simulated Prices and of School Expenditure. We test the hypothesis that favorable fluctuations in the international price of commodities increased the expenditure on schooling, which increased the number of voters due to literacy requirements. The expected sign is positive and it is an elasticity. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

	-1	-2	3	4	5	6	7	8
	Ln (Voters)	Ln (Voters)	Ln (Voters)	Ln (Voters)	Ln (Voters)	Ln (Voters)	Ln (Voters)	Ln (Voters)
Log(Price Index)	1.018***	0.849***	0.780**	0.748**				
	(0.25)	(0.16)	(0.31)	(0.29)				
Log (School Expenditure)					0.086	0.475**	0.421***	0.736***
					(0.32)	(0.22)	(0.11)	(0.24)
Log(Population)			0.14	0.005			1.182***	1.270***
			(0.39)	(0.77)			(0.15)	(0.15)
Log(Imports pc)			0.309**	0.314**				0.12
			(0.13)	(0.14)				(0.10)
Log(Exports pc)			-0.059	-0.04				-0.188
			(0.19)	(0.20)				(0.17)
Dummy Republic					4.432***	4.402***	3.074***	
					(0.17)	(0.20)	(0.22)	
Constant	5.696***	6.159***	3.745	5.703	6.453***	6.549***	-7.900***	-5.688**
	(1.23)	(0.80)	(4.01)	(9.74)	(0.28)	(0.34)	(1.87)	(2.01)
State Dummies	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Time Dummies	No	No	No	Yes	No	No	No	Yes
Observations	38	38	35	35	60	60	60	35
R-squared	0.268	0.966	0.979	0.979	0.807	0.959	0.986	0.985

	9	10	11	12	13	14	15	16
	Log (Voters/population)	Log (Voters/population)	Log (Voters/population)	Log (Voters/population)	Log (Voters/population)	Log (Voters/population)	Log (Voters/population)	Log (Voters/population)
Log(Price Index)	0.238*	0.222	0.780**	0.748**				
	(0.12)	(0.13)	(0.31)	(0.29)				
Log (School Expenditure)					0.154**	0.430***	0.421***	0.736***
					(0.07)	(0.08)	(0.11)	(0.24)
Log(Population)			-0.860**	-0.995			0.182	0.270*
			(0.39)	(0.77)			(0.15)	(0.15)
Log(Imports pc)			0.309**	0.314**				0.12
			(0.13)	(0.14)				(0.10)
Log(Exports pc)			-0.059	-0.04				-0.188
			(0.19)	(0.20)				(0.17)
Dummy Republic					3.299***	3.278***	3.074***	
					(0.12)	(0.15)	(0.22)	
Constant	-4.110***	-4.039***	3.745	5.703	-6.159***	-5.680***	-7.900***	-5.688**
	(0.57)	(0.65)	(4.01)	(9.74)	(0.08)	(0.17)	(1.87)	(2.01)
State Dummies	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Time Dummies	No	No	No	Yes	No	No	No	Yes
Observations	38	38	35	35	60	60	60	35
R-squared	0.103	0.699	0.869	0.87	0.954	0.968	0.97	0.904

Table 20. Diff-in-Diff Approach with Panel Data, 1901-1926. The dependent variable is the logarithm of the expenditure per capita in schooling . Regressions test the hypothesis that after 1890 state politicians increased more expenditures on education whenever there were higher revenues. We use total state revenues in this regressions because there is no data for export tax revenue before 1891. We expect to find positive coefficients on both state public revenue per capita and the interaction of that variable with a dummy variable that takes the value of 1 for all years after 1890. Variables in specifications 5 to 10 are in logarithms, so the coefficients are elasticities. Robust cluster standard errors shown in parenthesis. Coefficients marked with: *** indicates significant at 1%, ** at 5% and * at 10%

	(1) Exp. on education pc	(2) Exp. on education pc	(3) Exp. on education pc	(4) Log (Exp. on education pc)	(5) Log (Exp. on education pc)	(6) Log (Exp. on education pc)	(7) Log (Exp. on education pc)	(8) Log (Exp. on education pc)	(9) Log (Exp. on education pc)	(10) Log (Exp. on education pc)
Dummy(t>1890)*State Public Revenue pc		**-22.412**	**-30.986**							
		(14.116)	**(26.992)**							
Dummy(t>1890)		**-0.182***	**-0.594***		0.547	0.662	2.154***	0.662	0.736	0.138
		(0.092)	**(0.284)**		(0.572)	(0.562)	(0.613)	(0.562)	(0.553)	(0.516)
State Public Revenue pc	**76.251*** **	**99.570*** **	**87.150*** **							
	(13.904)	**(26.432)**	**(26.542)**							
Population			0.000*							
			(0.000)							
Exports pc			1.736							
			(2.215)							
Imports pc			3.296							
			(4.406)							
Dummy(t>1890)*Log(State Public Rev. pc)					**0.198***	**0.184***	**0.410*** **	**0.184***	**0.193***	**0.095**
					(0.106)	**(0.105)**	**(0.117)**	**(0.105)**	**(0.099)**	**(0.105)**
Log(State Public Revenue pc)				**0.385*** **	**0.521*** **	**0.507*** **		**0.507*** **	**0.506*** **	**0.484*** **
				(0.113)	**(0.122)**	**(0.123)**		**(0.123)**	**(0.124)**	**(0.133)**
Log(Population)									-0.082	0.128
									(0.392)	(0.417)
Log(Exports pc)										0.015
										(0.035)
Log (Imports pc)										0.098*
										(0.053)
Constant	0.081	0.275**	0.169	2.302***	2.843***	2.757***	-0.708***	2.757***	3.099	2.508
	(0.132)	(0.100)	(0.653)	(0.431)	(0.547)	(0.555)	(0.061)	(0.555)	(2.499)	(2.770)
State dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes
Observations	487	487	401	487	487	487	487	487	487	401
R-squared	0.790	0.793	0.816	0.773	0.816	0.802	0.763	0.802	0.803	0.787

Figure 1. Total flow of immigrants into Brazil (in thousands)

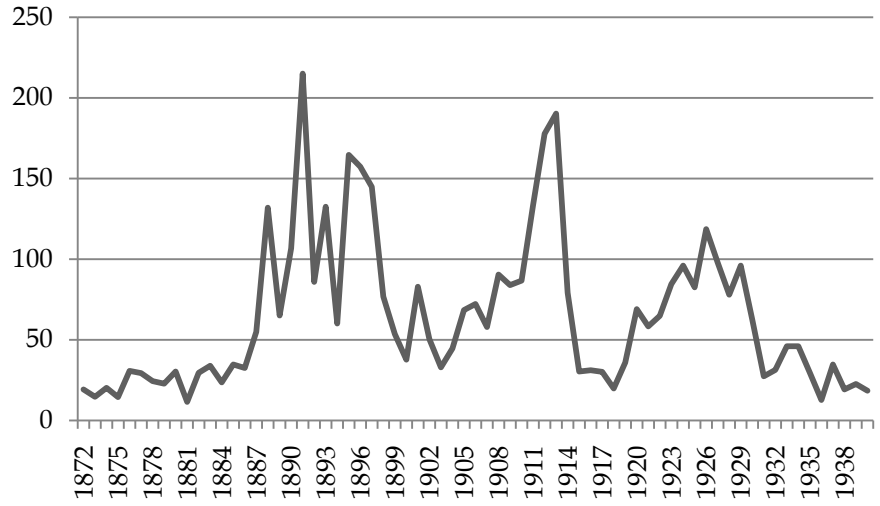
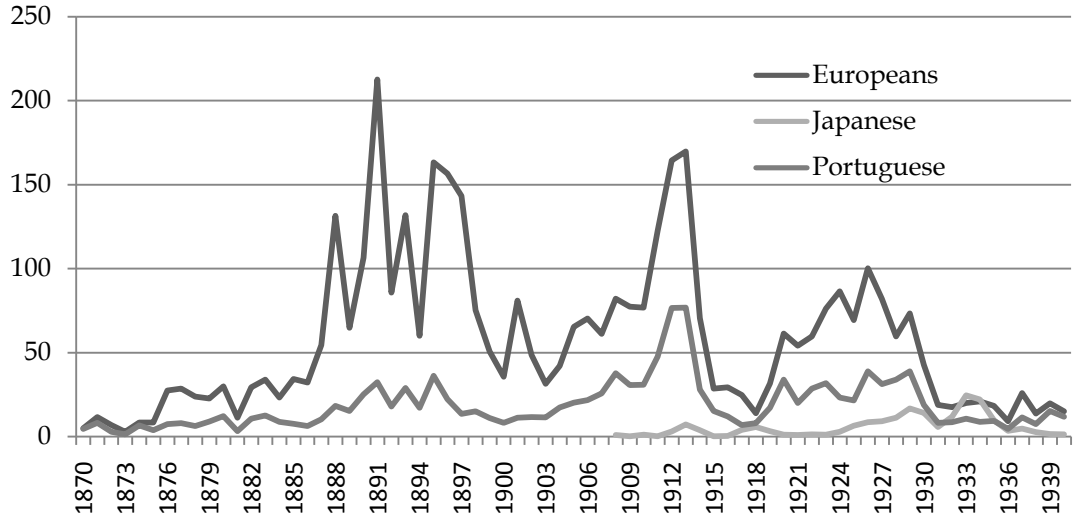


Figure 2. Immigration to Brazil by Cultural Background (in Thousands)



Source: Fernando L. de Barros Basto, *Movimento das Correntes Imigratórias do Brasil,* Rio de Janeiro, Estado do Rio de Janeiro, 2000.

Figure 3. Examining the Correlation between Industrialization and Skill Premium Variables with Education Indicators