

# The Efficiency Consequences of Institutional Change: The Political Economy of Financial Market Regulation and Industrial Productivity Growth in Brazil, 1866-1934

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## ABSTRACT

*This paper examines one of the central hypotheses of the New Institutional Economics: that the reform of institutions—the rules and regulations enforced by the State that both permit and bound the operation of markets—is crucial for the process of economic growth. It examines this hypothesis by estimating the productivity gain afforded to Brazilian textile firms by the reform of the regulations governing Brazil's securities markets in 1890. The paper argues that the reform of the regulations pertaining to limited liability and mandatory disclosure permitted the widespread use of Brazil's debt and equity markets to mobilize capital for industry. This meant that the capital constraints faced by firms prior to the 1890's were relaxed. The result was an increased rate of investment, a growth in the size of firms, and accelerated rates of growth of productivity.*

## KEY WORDS

*capital markets, productivity, Brazil, new institutional economics*

## RESUMO

*Este texto examina uma das hipóteses centrais da nova economia de instituições ("New Institutional Economics"): a idéia que a reforma de instituições é um elemento fundamental para o crescimento econômico. Esta hipótese é examinada por meio de estimativas a respeito dos avanços em produtividade na indústria têxtil brasileira, a partir da reforma das leis e regras que governavam o mercado de ações em 1890. O resultado da análise apóia a idéia que a reforma das regras relativas à responsabilidade limitada dos accionistas e a divulgação obrigatória de informações sobre as empresas permitiram um ampliado uso de empréstimos e ações ordinárias como meios de gerar capitais para a indústria, diminuindo, assim, as pressões por capital. O resultado foi um aumento na taxa de investimento, expansão no tamanho das indústrias e aceleradas taxas de crescimento na produtividade.*

## PALAVRAS-CHAVE

*mercados de capitais, produtividade, o Brasil, nova economia de instituições*

In recent years economists and economic historians have become increasingly interested in the role of institutional change in the process of economic growth. One of the major variants of the recent research on institutions, most commonly associated with Douglass North, holds that economic growth is the outcome of productivity increases that are brought about by the more efficient allocation of the factors of production through more smoothly functioning markets. At the core of increases in the efficiency of markets is the reform of institutions—the rules and regulations enforced by the State that both permit and bound the operation of markets. Institutional reform, these scholars argue, makes credible commitments possible, property rights more secure, and contracts enforceable, thereby lowering transactions costs and increasing the range of exchanges that are mediated through the market.<sup>1</sup>

This view is advanced not as a set of necessary truths, but as a set of hypotheses to be tested. Unfortunately, operationalizing the testable implications of these hypotheses has proved somewhat elusive: it is extraordinarily difficult to develop econometric evidence that demonstrates that changes in institutions makes markets function more smoothly, and that changes in the efficiency of markets has any demonstrable effect on productivity growth. Attempts to create such econometric evidence have largely been unsuccessful for four reasons. First, most scholars operating within the New Institutional Economics have looked at economies in which institutional change has taken place gradually. This has meant that it is difficult to pinpoint particular institutional reforms that have been crucial for the growth of productivity. Second, most scholars operating within the NIE have looked at economies that have had long histories of well developed markets. In these economies the market has anticipated institutional changes, meaning that it is difficult, if not impossible, to use the history of developed countries as a laboratory to assess the impact of institutional reforms.<sup>2</sup> Third, there is endogeneity that may exist between the market and institutional development: markets as they become more efficient may affect the process of institutional development, which,

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1 The literature on institutions and growth suggests various avenues through which institutional reform can enhance productivity growth. For example, institutions also include the rules governing contracts within firms. Changes in labor laws, to cite one example, can produce significant changes in work rules, which may allow for organizational innovation by firms, thereby increasing productivity. This paper only considers one variant of the institutional literature and therefore concentrates on how changes in the institutions governing markets enhance productivity growth. For the most succinct statement of this view see North, *Institutions*. For a survey and analysis of the different institutionalist approaches see GREIF, “Micro Theory.”

2 The notion here is that economic agents realize that there is about to be a reform of institutions, and so bid up or down asset prices accordingly. This point is made by CLARK, “Political Foundations.”

in turn, feeds back into markets, and so on. Fourth, there are numerous technical difficulties in the measurement of productivity, which are made even more difficult still by the problem of tying any change in the growth of productivity to some exogenous change in institutions.

The most unambiguous results in institutional analysis are therefore to be found in those historical cases where there have been dramatic changes in institutions, where markets were not well developed prior to those institutional changes, and where there is sufficient quantitative data available to measure the productivity consequences of institutional change.<sup>3</sup> An ideal laboratory for this kind of research is the economic history of less developed economies during the early stages of their economic development.

This paper offers a contribution to this literature through the examination of the history of capital market regulation and industrial productivity growth in Brazil during the period 1866 to 1934. I focus on capital market regulation because capital markets are especially crucial for economic growth and are also notoriously subject to government regulation. Indeed, it is widely accepted that the details of such regulation have profound effects on the structure of banking and securities markets. What is less clear is whether these differences in the structure of capital markets has any discernible impact on the performance of the rest of the economy.<sup>4</sup>

I focus on the case of Brazil during the period 1866-1934 for the following reasons. First, Brazil provides a counterfactual test of the proposition that the specific features of government regulation have a profound effect on the development of securities markets because the overthrow of the Brazilian monarchy in 1889 and

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3 For an analysis of the impact of the French Revolution on the institutions that constrained agricultural productivity growth prior to 1789 see ROSENTHAL, *Fruits of Revolution*.

4 The term capital markets is used here to mean the organized process by which banks, brokers, and exchanges raise, securitize, distribute, trade, and continually value investment funds. Though the exact mechanisms are rarely examined empirically, one can infer from the literature that there are four channels through which the development of capital markets increases the efficiency of the rest of the economy. First, by eliminating the need for savers and investors to have direct knowledge of one another, capital markets increase allocative efficiency: funds flow to those entrepreneurs who can provide savers with the highest risk-adjusted rate of return. Second, by lowering the cost of capital to firms (and potential firms), capital markets allow entrepreneurs greater flexibility in their choice of the capital-labor ratio. Third, by allowing firms the ability to grow far more rapidly than they would be able to otherwise, capital markets permit firms to rapidly reach the size at which they can take advantage of potential scale economies in production. Fourth, by lowering the cost of capital to entrepreneurs and potential entrepreneurs, new firms come into existence that would not have existed otherwise. The result is an increase in the rate of technical change (because new firms are putting physical plants of more recent vintage into service) and increased competition, which intensifies entrepreneurial efforts to raise productivity through new technological and organizational innovations. For a comparison of the U.S. and German cases, arguing that Germany had a more efficient financial system because of differences in the regulation of banking, see CALOMIRIS, "Costs."

the founding of a federal republic brought about a dramatic revision of the pre-existing laws. Second, by focusing on the early stages of the development of the securities markets the problem of simultaneity is eliminated: the market could not anticipate changes in institutions because the market was poorly developed prior to these changes in regulation. Third, Brazil is unusual in that there is abundant data at the firm level that permits the estimation of productivity growth by firm type and size. It is therefore possible in the Brazilian case to estimate the efficiency gains afforded to manufacturers by calculating the differences in the levels of total factor productivity between those firms that mobilized capital by selling debt and equity to the investing public and those that used more traditional, personalized channels.

I carry out this analysis using panel data techniques, which involve linking together 18 censuses covering the period 1866-1934 with production, financial, and dummy variable information for 558 textile firms. I estimate time-series, cross-sectional regressions for the census years following the institutional reforms of the 1890's (the years 1905-1927) that permit the measurement of the the impact of the ability of firms to take the joint-stock corporate form, sell equity on the public markets, and issue bonded debt on their level of total factor productivity.

I argue that changes in government regulations had a profound effect on the growth and performance of industry. The first reform was the establishment of limited liability. Limited liability overcame a fundamental asymmetry in incentives: before 1890 the law created disincentives for entrepreneurs to issue debt and disincentives for investors to purchase equity because an investor was held to be fully liable for a firm's debts in the case of insolvency, even if had traded away the stock. From the point of view of founding groups of investors, the new limited liability law meant that they could go out to the debt markets and not be personally liable for those debts if the company failed. From the point of view of potential investors from outside the founding groups, limited liability meant that they could purchase equity shares in firms and not have to be concerned that they would be held personally liable for the firm's debts if it went bankrupt.

The second crucial reform in securities markets were those related to mandatory disclosure. The 1890 regulatory law required firms to produce financial statements, reprint at least the balance sheets in public documents, such as a newspaper or state gazette, and include a statement in the report about the identities of each stockholder and the number of shares they owned. In the early stages of the use of the market is it likely the case that investors made decisions about which firms to invest in based on the reputations of the founding group of entrepreneurs. Over time, however, potential investors had far more information to go on: they knew who held controlling interest in the firm and they had a great deal of financial

information available, including the firm's history of dividend payments, its level of indebtedness, the size of its reserves, and the liquidity of their investment.

The effects of these regulatory reforms was to reduce transaction and monitoring costs, thereby lowering the cost of capital to firms that adopted the joint stock, limited liability form. First, mandatory disclosure made it easier for investors to monitor managers. Second, limited liability eliminates the need for investors to monitor one another. In a situation in which liability is not limited, investors must create costly covenants that restrict the transferability of ownership rights to individuals with sufficient wealth to cover their share of any liability resulting from insolvency. Alternatively, investors must engage in costly monitoring to verify the liquidity of their partners.<sup>5</sup> In the absence of these reforms, access to capital could have served as a barrier to entry because some firms could have used the reputational capital or personal connections of their owners to obtain investment funds from third parties, while most other firms would not have been able to do so.

Prior to these reforms few firms utilized the market to mobilize capital, and Brazilian industry was small in size - even by Latin American standards. After the reforms, large numbers of firms were financed through the sale of stocks and bonds to the investing public. The result of lower capital costs was that already existing firms were able to grow faster than they could have otherwise, and new firms could enter the market because their cost of capital was lower than their expected, risk adjusted rate of return. Not only did industry grow by leaps and bounds (capacity, as measured by spindlage, grew nearly 30-fold from 1881 to 1925), but limited liability, joint stock companies became the dominant form of corporate organization. In the case under study here - the cotton textile industry - 70 percent of the industry's installed capacity in 1925 was located in joint-stock firms.

The use of the securities markets had similarly unambiguous effects on the performance of industry. There was a sizable difference in absolute levels and rates of growth of productivity between firms that used the markets to obtain finance and those that continued to mobilize capital through traditional, informal avenues. These differences in total factor productivity (TFP) hold regardless of firm size. The primary impact of the securities markets on productivity was not, therefore, that joint stock firms could take advantage of economies of scale in production. The increase in TFP was produced by the fact that limited liability joint stock companies were able to move into the market for fine-weave, high quality output, which earned a price premium. Because the production of high quality output requires machines to be run more slowly, it necessitates more machines per worker than the production of low quality cloth. Under these conditions, firms with access

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5 See CARR AND MATHEWSON, "Unlimited Liability," p. 766-784.

to low cost capital had a distinct advantage. Thus, limited liability joint stock companies were able to use their access to relatively less expensive capital to move into this market, while privately-owned firms, which tended to be more capital constrained were not. The result was increased allocative efficiency: those entrepreneurs who could best combine the factors of production and choose the optimal output mix were able to mobilize capital that otherwise would not have been available to them. The implication is that had it been difficult for smaller entrepreneurs to use the securities markets to obtain investment capital, the growth of TFP in Brazilian cotton textile manufacturing would have been significantly lower.

One might argue that causality ran the other way: Firms did not have high TFP because they were publicly owned, they were publicly owned because they had high TFP or because they were founded by entrepreneurs with a proven track record of business success in other areas. There are two problems with this line of reasoning. The first is that most limited liability joint stock companies did not start out as privately-owned firms that at some point in their life cycle decided to change corporate form. In the vast majority of cases, publicly owned firms were entirely new enterprises without track records in the textile industry: their initial finance came from the sale of equity to the investing public. The second problem is that from the point of view of economic growth it does not matter whether entrepreneurs were screened in some way by brokers or other intermediaries based on their previous record. Had the securities markets not existed, or had access to them been limited in some way, these more able entrepreneurs would have been capital constrained. They therefore would have directed smaller enterprises, or perhaps not founded firms at all. The result would have been a deadweight loss to the Brazilian economy.

This is not to argue that the only constraint faced by Brazilian industry was access to capital, and that the only relevant policy change in Brazil related to the regulation of financial markets. Coterminous with the reform of financial market regulations were increases in tariff protection and the expansion of the railroad network, which had begun to develop in the 1880's but which now grew rapidly under the combined influence of federal subsidies and the availability of foreign capital.<sup>6</sup> It is to argue, however, that one crucial piece of the puzzle explaining the lack of industrial development before 1890 and rapid industrial growth after 1890 was access to capital. Changes in the rules and regulations governing the operation of banks and capital markets were a necessary, but not a sufficient, condition for the expansion of Brazilian industry.

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6 On the impact of Brazil's inefficient railroad system see Summerhill, "Transport Improvements." On the myriad problems constraining growth in nineteenth century Brazil see LEFF, *Underdevelopment and Development*; and LEFF, "Economic Development."



This paper is organized into four sections. Section I explains the choice of the textile industry as a test case and discusses the data sources and their limitations. Section II discusses the institutional history of financial market regulation in Brazil. Section III examines the effects of these reforms, paying particular attention to the impact of greater use of the financial markets on industrial productivity. Section IV concludes.

### *I - COTTON TEXTILES AS A TEST CASE*

This paper focuses on the cotton textile manufacture, but I would expect that the relationships between access to capital, firm size, and TFP growth would extend to a broad range of industries in early twentieth century Brazil. In fact, Brazil's securities markets were used to mobilize capital for urban tramways and municipal railroads, utility companies, navigation companies, banks, insurance companies, and sugar refineries, as well as a diverse range of industrial enterprises, including beer breweries, food processors, glassworks, and cement manufacturers.

I focus on the cotton textile industry for both practical and theoretical reasons. First, cotton textiles were the most important manufacturing industry in Brazil during the period under study.<sup>7</sup> Second, both the Brazilian government and Brazil's various manufacturers' associations regularly gathered systematic census-type data on the textile industry which permit the estimation of TFP. Third, there are compelling theoretical reasons to focus on cotton textiles. Textile manufacturing is characterized by capital divisibilities and modest scale economies. Thus, the minimum efficient scale of production is small enough that firms may be financed through traditional sole proprietor and partnership arrangements, as well as through the use of impersonal financial markets. This permits productivity comparisons across various firm types and sizes that would not be possible in most other mechanized industries, such as cement, beer, chemicals, or steel, where there were few firms that were not financed through the sale of equity.<sup>8</sup>

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7 As Kuznets pointed out, textiles tend to be the first manufacturing industry to develop as economies modernize. Brazil conformed to this general pattern. At the time of Brazil's first full-scale industrial census in 1920, cotton textiles accounted for 24.4 percent of manufacturing value added, a higher percent than any other manufacturing activity. See KUZNETS, *Economic Growth*, p.111-113; see also HABER, "Business Enterprise."

8 This does not mean that there were no scale economies in cotton textile production. Indeed, had the minimum efficient scale of production been extremely small—such as that found in industries like bee's wax candle making, differences in access to low cost capital could not have played a role in raising productivity. It does mean, however, that economies of scale were exhausted in textiles at relatively small firm sizes compared to industries such as steel, cement, or chemicals. Indeed, the estimates of firm level TFP later in this paper indicate a minimum efficient scale equivalent to a market share of less than one-half of one percent.

*The Data*

The analysis presented here rests on three bodies of evidence. The first are the censuses that cover all of the mechanized cotton textile companies - both privately and publicly-owned - operating in Brazil. Prior to the 1890's this is roughly 20 firms, growing to 117 firms by 1907, to 205 firms by 1914, and to 228 firms in 1927. In addition to carrying information about each firm's output (by both value and volume), machinery, and workforce, these censuses also identify the owners of each mill and (from 1905 to 1934) include detailed financial information about each firm. I have retrieved and put into machine-readable form the censuses from 1866, 1875, 1881, 1883, 1895, 1898, 1901, 1905, 1907, 1908, 1914, 1915, 1923, 1924, 1925, 1926, 1927, and 1934.<sup>9</sup> Because the data is presented in each census at the firm level, it is possible to cross-check individual firm's reported data from census to census in order to isolate errors in variables. The detailed nature of the census also permits the calculation of ratios of factor inputs to one another and to various types of output in order to isolate firms that clearly under or over-reported inputs and outputs. Following earlier researchers, I culled these observations from the data sets used to estimate production functions and factor productivity.<sup>10</sup> One caveat holds for all the censuses: many of the smallest privately owned firms provided only partial responses to the census. Since these very small firms tended to account for a small percentage of output, but a correspondingly high percentage of factor inputs, their exclusion from the estimation of production functions and total factor productivity (TFP) likely biases the TFP estimates for small, privately-owned firms upwards. This biases the results against the hypotheses advanced in this paper.

The second body of evidence analyzed here are the semi-annual financial statements of 15 publicly-traded cotton textile manufacturing firms covering the years 1895 to 1940. These 15 firms are not a random sample, but were chosen because it was

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9 Some of these are only partial censuses: the 1895 census only reports the returns from large firms, the 1901 and 1908 censuses are strongly biased toward São Paulo firms, and 1923 only reports large firms that were members of the Rio de Janeiro cotton textile manufacturer's association. The others are all nation-wide censuses of all mechanized firms.

10 See, for example, GRILICHES AND RINGSTAD, *Economies of Scale*.



possible to retrieve complete sets of their financial statements.<sup>11</sup> These 15 firms controlled 42 percent of the industry's installed capacity in 1905 and 24 percent even as late as 1934. It is clear from comparing the financial data in the censuses to the financial data in these reports that these firms were more likely to have significant long-term bonded debt than was the norm, even for publicly-traded, joint stock companies. These financial statements permit, however, the more detailed study of the structure of debt and equity than do the censuses.

The third body of evidence is data on the secondary markets for textile firm securities that was retrieved from the major newspapers for Rio de Janeiro and Sao Paulo. In addition, small, regional stock exchanges operated in Bahia, Pernambuco, Minas Gerais, and other states as well, and it appears that, like the Rio de Janeiro and Sao Paulo exchanges, these served as secondary markets for the debt and equity of nearby cotton mills.<sup>12</sup> No data has been retrieved on these smaller markets.

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11 The 15 firms are: Companhia de Fiação e Tecidos Aliança, Companhia America Fabril, Companhia Brasil Industrial, Companhia de Fiação e Tecelagem Carioca, Companhia de Fiação e Tecidos Industrial Campista, Companhia de Fiação e Tecidos Cometa, Companhia de Fiação e Tecidos Confiança Industrial, Companhia de Fiação e Tecidos Corcovado, Companhia de Fiação e Tecidos Industrial Mineira, Companhia de Fiação e Tecidos Mageense, Companhia Manufactora Fluminense, Companhia Petropolitana, Companhia Progresso Industrial do Brasil, Companhia de Fiação e Tecidos Santo Aleixo, Companhia Fábrica de Tecidos São Pedro de Alcântara.

Some of these reports were located in the Bibliotheca Nacional in Rio de Janeiro, filed erroneously in the Periodicals Section. Most were retrieved from the *Journal do Commercio* (Rio de Janeiro's major financial daily) and the *Diario Official* (Brazil's equivalent of the Federal Register). In theory, it would be possible to retrieve the reports of all publicly traded companies from these and similar sources - such as the *Diario Official* for each state and the major financial daily's of all the major cities, because under Brazilian law firms had to reprint abbreviated versions of their financial statements in public venues. In practice, however, this is a costly procedure because none of the relevant publications are indexed and each runs to roughly 20,000 pages per year. I therefore concentrated on the months of January, February, March, April, July, and August (when most firms produced their financial statements) for the *Jornal do Commercio* and the *Diario Official*. Research in progress is retrieving reports published in *O Estado de São Paulo* (São Paulo's major newspaper) and the *Diario Official do Estado de São Paulo*. Even restricting analysis to these four publications and concentrating solely on the months listed above still requires the researcher to look at roughly 1 million frames of microfilm to cover the 60 years from 1880 to 1940.

12 RIDINGS, *Business Interest Groups*, p. 294.

## II - TEXTILE FINANCE BEFORE 1890

Throughout most of the nineteenth century, institutions designed to mobilize impersonal sources of capital were largely absent in Brazil. An organized stock exchange had functioned in Rio de Janeiro since early in the century, but it was small and was seldom used to finance industrial companies. Brazil's mill owners could also not appeal to the banking system to provide them with capital: As late as 1888 Brazil had only 26 banks, whose combined capital totaled only 145,000 contos - roughly \$48 million U.S. Only seven of the country's 20 states had any banks at all, and half of all deposits were held by a few banks in Rio de Janeiro.<sup>13</sup> The absence of banks not only restricted the amount of credit available to textile entrepreneurs, but it also meant that banks could not underwrite securities trading or finance securities speculation the way they did in the United States or Western Europe.

The slow development of these institutions can be traced in large part to public policies designed to restrict entry into banking and limit abuses of the public by unscrupulous corporate promoters. The imperial government, which held the right to charter banks, was primarily concerned with creating a small number of super-banks that could serve as a source of government finance and that would promote monetary stability. Unfortunately, the government's continual shift in regulatory policies prevented the development of even a tightly controlled, centralized banking system along the lines of many Western European countries.<sup>14</sup>

The imperial government also created regulations designed to discourage the corporate form of ownership. Brazil's 1860 incorporation law required the promoters of joint stock companies to obtain the special permission of the imperial government, prohibited investors from purchasing stocks on margin, and restricted banks from investing in corporate securities. In addition, it did not permit limited liability. In fact, under Brazilian law an investor could be held liable for a firm's debts for a period of five years after he had sold the stock.<sup>15</sup>

13 TOPIK, *Political Economy*, p. 28.

14 TOPIK, *Political Economy*, p. 28. PELÁEZ AND SUZIGAN, *História monetária*, chaps. 2-5; SAES, *Crédito e bancos*, p. 22, 73, 27-86; LEVY, *História da bolsa*, p. 109-112; STEIN, *Brazilian Cotton Textile Manufacture*, p. 25-27; SYLLA, *American Capital Market*, p. 52, 209.

15 Presumably this provision of the law was meant to protect individuals and enterprises doing business with joint stock companies, as well as to protect outside investors from being fleeced by unscrupulous corporate promoters. The fear evidently was that individuals would found a firm, take on large amounts of debt, sell virtually all of the stock to outsiders, transfer the wealth of the firm to themselves, and then leave their creditors holding unrepayable debts and the outside investors holding watered stock. LEVY, *História da bolsa*, p. 117; PELÁEZ AND SUZIGAN, *História monetária*, p. 78-83, 96-97; SAES, *Crédito e bancos*, p. 22, 86; HANLEY, "Capital Markets"; RIDINGS, *Business Interest Groups*.

Given these constraints on the formation of financial intermediaries, the securities markets were rarely used to mobilize capital for industry. Not coincidentally, the textile industry remained small. In 1866 the entire modern sector of the industry numbered nine firms, none of which were joint stock companies. The early 1870's witnessed the creation of two joint stock companies that raised their initial capital through public offerings in Rio de Janeiro.<sup>16</sup> Even with these two joint stock companies, the capacity of the Brazilian cotton textile industry was only 85,000 spindles 1881 (see Table 1 ).<sup>17</sup> Not only was this minuscule by the standards of the United States, which in 1880 had an industry of some 10.6 million spindles, but it was small even by Latin American standards. Circa 1880, Mexico's cotton textile industry was more than three times the size of Brazil's (249,000 spindles) even though Mexican national income was only 55 percent that of Brazil.<sup>18</sup>

### *Regulatory Reforms and Outcomes*

In the last decades of the nineteenth century a dramatic reform of the regulations governing Brazil's capital markets took place. These changes began in 1882, when the government removed the requirement that joint stock companies obtain special charters from parliament. This reform also lowered, from 25 to 20 percent, the amount of paid-in capital required before the stock could be traded. Investors were still liable in the case of insolvency, however, for the firm's debts, even if those shares had been traded away as long as five years before.<sup>19</sup> As one might imagine, the lack of limited liability meant that these reforms had very little effect on the use of the stock and bond markets as sources of industrial investment.

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16 BORJA CASTRO, "Relatorio," 1866; Comissão de Inquerito Industrial, *Relatorio*.

17 Spindlage is used as the index for capacity because it is widely agreed that it provides the best proxy for physical capital.

18 Mexican textile data from HABER, "Financial Markets," p. 33. National income data from COATSWORTH, "Obstacles," p. 82. Note that Mexico and Brazil had roughly similar population sizes in the early 1880's, 9.1 million and 9.9 million, respectively.

19 HANLEY, "Capital Markets," p. 24, 27.

TABLE 1 - PARTICIPATION OF LIMITED LIABILITY JOINT STOCK FIRMS IN THE BRAZILIAN COTTON TEXTILE INDUSTRY, 1866-1934

Year	Total Firms	Total Spindles	Number of Joint Stock Firms				Capacity of Joint Stock Firms (measured in spindles)			
			Rio de Janeiro <sup>a</sup>	São Paulo	All States <sup>b</sup>	% of Total	Rio de Janeiro <sup>a</sup>	São Paulo	All States <sup>b</sup>	% of Total
1866	9	14.875								
1875	11	45.830	1		1	9%	20.000		20.000	44%
1881	24	84.956	2		2	8%	29.660		29.660	35%
1883	24	78.908	2		2	8%	25.500		25.500	32%
1885 <sup>c</sup>		66.466 <sup>c</sup>								
1895 <sup>c</sup>	22	260.842	9	2	13	--	164.405	8.204	192.275	--
1898 <sup>d</sup>	18	279.666 <sup>d</sup>	14		14	--	255.578		255.578	--
1905	90	778.224	17	3	25	28%	316.310	27.606	358.740	46%
1907	117	823.343	19	5	30	26%	321.783	65.329	402.863	49%
1908 <sup>c</sup>	119	761.816 <sup>c</sup>	10	6	16	13%	267.011	62.857	329.867	--
1914	205	1.634.449	25	29	66	32%	512.387	384.206	983.404	60%
1915	170	1.598.568	25	25	63	37%	517.757	358.096	972.935	61%
1921 <sup>c</sup>	242	1.621.300 <sup>c</sup>								
1923 <sup>c</sup>	243	1.700.000 <sup>c</sup>								
1924	184	2.200.612	23	27	69	38%	821.682	521.934	1.475.982	67%
1925	183	2.397.380	25	34	80	44%	870.226	668.710	1.689.357	70%
1926	215	2.558.433	23	44	92	43%	890.902	700.261	1.751.761	68%
1927	228	2.692.077	25	41	94	41%	880.561	719.871	1.788.244	66%
1934	203	2.507.126	26	32	83	41%	796.696	624.314	1.618.310	65%

<sup>a</sup> Includes Distrito Federal firms; <sup>b</sup> This is a national count of limited liability joint stock companies, including RJ and SP firms; <sup>c</sup> Estimate based upon partial information; <sup>d</sup> Includes only RJ and DF firms.

Sources:

1866 Borja Castro, "Relatório," p. 3-73.

1875 Comissão (para) Exposição Universal (em) Philadelphia, *Empire of Brazil*, p. 285-287 and statistical tables.

1881 Bibliotheca da Associação Industrial, *Arquivo da Exposição*, pp. xcvi-xcvii. Comissão de Inquerito Nacional, *Relatório*, p. 15.

1883 Branner, "Cotton Factories of Brazil - 1883."

1885<sup>c</sup> Consul Ricketts, *Report*, C4657, 1xv(1886), p. 187-188 as cited by Stein, *Brazilian Cotton*, Appendix I.

1895<sup>c</sup> dos Santos Pires, *Relatório*, p. 24-25.

1898<sup>d</sup> de Carvalho, "Café." Also, de Carvalho, "Algodão."

1905 Cunha Vasco, "Indústria de Algodão."

1907 Censo Industrial do Brasil, "Indústria de Transportes." Prefeitura do Distrito Federal, *Notícia*.

1908 Graham Clark, *Cotton Goods*; Cunha Vasco, *Fábrica de Fiação*, Bandeira Junior, *Indústria no Estado de São Paulo*.

1914 Centro Industrial do Brasil, *Relatório da Directoria*, 1915.

1915 Centro Industrial do Brasil, *Centro na Conferência Algodoeira*.

1921<sup>c</sup> Centro Industrial de Fiação e Tecelagem de Algodão (hereafter CIFTA), *Relatório da Directoria*, 1921-1922.

1923<sup>c</sup> CIFTA, *Exposição de Tecidos CIFTA*, *Relatório de Directoria*, 1923.

1924 CIFTA, *Relatório da Directoria*, 1924.

1925 CIFTA, *Relatório da Directoria*, 1925.

1926 CIFTA, *Fábricas Filiadas*.

1927 CIFTA, *Relatório da Directoria*, 1928.

1934 CIFTA, *Fiação e Tecelagem*.

The real impetus to regulatory reform did not get underway until 1888, when the imperial government abolished slavery. The end of slavery produced a series of unexpected and unintended outcomes that set in motion both the overthrow of the monarchy and the complete reform of banking and securities market regulation. Abolition drove a wedge between Brazil's planter class, which historically had been the mainstay of the monarchy, and the imperial government. In an effort to placate the planters by making credit more easily available to them, the imperial government awarded concessions to 12 banks of issue and provided 17 banks with interest free loans. The easy credit policies of 1888 were not enough, however, to stem the tide of Brazil's republican movement, which saw the monarchy and its policies as inimical to the creation of a modern economy and society. In November of 1889 Dom Pedro II, Brazil's emperor, was overthrown and a federal republic was created.

The newly-created federal system shifted the weight of political power away from the Northeast and toward the richer, faster growing South, particularly the states of Sao Paulo and Rio de Janeiro, which used their newly-found political power to push through regulatory reforms that would maximize economic growth within their borders. Three reforms were especially crucial. First, the government deregulated the banking industry: banks could now engage in whatever kind of financial transactions they wished, including the right to extend long term loans and to invest in corporate securities. Second, the government dramatically reduced shareholder liability. Shareholders were still liable for the face value of their shares, but only until the annual shareholder's meeting when the financial records were approved. This effectively limited their liability to a 12 month period.<sup>20</sup> Third, the government instituted a set of mandatory disclosure laws that were highly unusual for the time. Brazil's publicly-owned corporations were required to produce financial statements annually (many in fact produced them twice per year) and reprint them in public documents, such as state or federal gazettes or the newspaper. In addition, their annual reports had to list the names of all shareholders and the number of shares they controlled. Finally, the annual report had to list the number of shares that had changed hands during the year, including information on the number of shares that traded in each transaction. Investors could thus obtain reasonably good information on the health of firms, the potential liquidity of their shares, and the identities of a firm's major shareholders.<sup>21</sup>

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20 HANLEY, "Capital Markets," p. 24-28; Topik, *Political Economy*, pp. 28-32; PELÁEZ AND SUZIGAN, *História monetária*, p. 141-143. STEIN, *Brazilian Cotton Textile Manufacture*, p. 86.

21 Shareholder lists were not always published in the abbreviated reports reprinted in the newspapers, but they were published in the original reports.

The results of these reforms were dramatic. The nominal capital of corporations listed on the Rio de Janeiro and São Paulo exchanges, which had stood at 410,000 contos (roughly \$136 million) in May of 1888, doubled to 963,965 contos by December 1889 under the impact of the new banking laws, and then doubled again by December 1890 when the use of the markets spread to other areas of economic activity. By December 1891, it reached 3,778,695 contos, a four-fold increase in just three years.<sup>22</sup>

In the short term, the speculative bubble created by the Encilhamento financed large numbers of banks. Though many of the banking enterprises failed during the collapse of the bubble and the recurrent financial crises over the following decade, in the short run they provided loans to Brazil's textile industry. In some cases, banks directly organized and ran textile companies.

Bank-financed industrial development was not, however, to be long lasting in Brazil. The boom created by the Encilhamento created a speculative bubble, which burst in 1892 bringing down many of the banks. The government therefore decided in 1896 to once again restrict the right to issue currency to a single bank acting as the agent of the treasury. These more restrictive regulations, coupled with the already shaky financial situation of many of the banks produced a massive contraction of the banking sector. In 1891 there were 68 banks operating in Brazil. By 1906 there were only ten, and their capital was only one-ninth that of the 1891 banks.<sup>23</sup> The banking system then began to expand, led and controlled by a semi-official super-bank, the third Banco do Brasil, which acted both as a commercial bank and as the treasury's financial agent.

After the contraction of the banking system in 1896, Brazil's banks appear to have lent very little money for long-term investment.<sup>24</sup> Banks played an important role, however, in providing short-term, working capital to manufacturers by discounting commercial paper. As Table 2 shows, for the 15 firms whose balance sheets I have retrieved, during the period 1895-1915 short-term debt accounted for from 29 to 42 percent (depending on the year) of their total indebtedness.

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22 1888 data from NEUHAUS, *História monetária do Brasil*, p. 19ff. Data for 1889, 1890, and 1891 calculated from *O Estado de São Paulo* and *Jornal do Commercio*, consolidated stock tables. See table 1. A conto was equal to 1,000 milreis, the basic unit of Brazilian currency. There were roughly three milreis to the dollar in 1890.

23 NEUHAUS, *História monetária do Brasil*, p. 22. For a discussion of bank portfolios see HANLEY, "Capital Markets;" Triner, "Banks."

The more important, long-run effect of the Encilhamento was that the regulatory reforms of the securities markets gave rise to the widespread sale of equity and bonded debt to the investing public in order to mobilize long-term capital. Essentially, corporate finance took the following form: a group of entrepreneurs tied through kinship or established business relationships would come together and found a joint stock company. They would then issue a prospectus, find a broker or bank to act as an intermediary, and sell shares to the public. These offerings would often be advertised in newspapers or state gazettes. As a firm's capital requirements grew it would either issue new shares, which would be advertised in a public offering and handled by a broker, or they would issue bonds which would also be subscribed by the public through the services of a broker or a bank. Over time, therefore, stock ownership grew more diversified and individuals could choose between owning equity or owning debt. In the early stages of the development of the market this looked much like the Boston Stock Exchange: stocks tended to be closely held by the founding groups. Gradually, however, stock ownership became more diversified, particularly for the larger, more successful companies. By the 1920's, larger companies typically had more than 100 shareholders, and the rate of turnover of shares in the secondary markets was roughly 10 percent per year. It was also generally the case that no individual stockholder controlled more than 10 percent of a firm's shares. In fact, in the country's largest firm, the Companhia America Fabril, the minority shareholders actually banded together in the early 1920's and forced a reform of the board of directors, removing the founding group of entrepreneurs from their control of the firm.<sup>25</sup>

The overall process is reflected in table 1. In 1866 there were no joint stock companies in the cotton textile industry. By the early 1880's there were two, accounting for 32 percent of the industry's installed capacity. By 1895, 13 joint stock firms had been founded, and their capacity was seven times that of the joint stock companies in 1883. This mushroomed to 66 joint stock firms (accounting for 60 percent of industry capacity) by 1914, and to 80 joint stock firms (accounting for 70 percent of capacity) by 1925.

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25 VON DE WEID AND RODRIGUES BASTOS, *Fio da meada*.



TABLE 2 - DEBT EQUITY RATIOS AND SOURCES OF NEW CAPITAL FOR  
15-FIRM SAMPLE, 1895-1940  
*Estimated From Balance Sheets, Includes Short-Term Debt*

Panel I:						Composite Debt Equity Ratios (Weighted by Total Liabilities)				
Liabilities (millions of mil-reis)										
Year	Paid Capital	Retained Earnings	Short Term Debt	Bond Debt	Total Liabilities	Debt Equity Ratio	Short Term/ Debt	Bond Debt/ Debt + Equity	Retained Earnings/ Debt + Equity	Paid Capital/ Debt + Equity
1895	10	1	2	5	19	0,68	0,29	0,29	0,06	0,53
1900	53	16	9	19	96	0,39	0,31	0,19	0,16	0,55
1905	61	30	7	16	115	0,26	0,31	0,14	0,26	0,53
1910	76	28	19	26	149	0,43	0,42	0,18	0,19	0,51
1915	81	30	26	38	175	0,57	0,41	0,22	0,17	0,46
1920	115	43	21	45	224	0,41	0,32	0,20	0,19	0,51
1925	145	118	54	39	357	0,35	0,58	0,11	0,33	0,41
1930	137	100	65	78	380	0,60	0,45	0,21	0,26	0,36
1935	135	124	66	64	389	0,50	0,51	0,17	0,32	0,35
1940	145	143	74	46	409	0,42	0,62	0,11	0,35	0,36

  

Panel II:					
Sources of New Capital (Weighted by Total Liabilities)					
Period	Growth of Debt+Equity	Share of Short-term Debt	Share of Bond Debt	Share of Retained Earnings	Share of Paid Capital
1895-00	410,8%	8,1%	17,1%	18,9%	55,9%
1900-05	19,3%	-6,2%	-13,0%	77,5%	41,8%
1905-10	30,3%	33,2%	28,8%	-5,0%	43,0%
1910-15	16,9%	28,8%	45,2%	5,9%	20,1%
1915-20	28,1%	-11,3%	14,8%	27,5%	69,0%
1920-25	59,4%	25,1%	-4,2%	56,3%	22,8%
1925-30	6,5%	46,1%	170,1%	-78,8%	-37,3%
1930-35	2,5%	13,5%	-145,2%	251,0%	-19,3%
1935-40	4,9%	41,3%	-96,0%	100,9%	53,8%

Source: See note 11 in the text.

By the standards of other countries during the early stages of industrialization this is an impressively high percentage of firms mobilizing capital through the sale of equity. Even as late as 1860, when the Boston Stock Exchange was at its peak importance as a source of capital for New England's mechanized mills, only 40 firms were listed on the exchange, out of a total of 1,091 firms in operations in the United States.<sup>26</sup> Perhaps the most relevant example is Mexico, a nation of similar per capita income and level of industrial development. Only four of Mexico's 100 operating textile firms in 1912 sold equity on the Mexico City Bolsa. Moreover, in Mexico there was little entry and exit from the financial markets. The same four firms listed on the exchange in Mexico in the late 1890's were the only four publicly

26 On the financing of the New England Textile Industry see MCGOULDRIK, *New England Textiles*; DAVIS, "Sources."

owned cotton textile producers listed on the exchange until the 1940's.<sup>27</sup> In Brazil, on the other hand, there was a high degree of entry and exit.

Moreover, it was not the case, as it was in the mid-nineteenth century United States, that Brazilian firms issued equity once and then funded their subsequent growth out of retained earnings.<sup>28</sup> Rather, firms regularly went back to the financial markets to seek new equity to fund their rapid expansion. Fourteen of the 15 firms whose balance sheets I have studied in detail raised additional equity capital from the investing public after they had been in business for some time.

As important as the development of the equities markets in Brazil was the simultaneous development of markets for long term debt. As was the case with equities, debt issues came in small denominations: virtually all had a par value of 200 milréis (about \$50 at the rate of exchange at the turn of the century), implying that they could be held by medium sized savers. These debts took the form of general obligation bonds, were callable, carried nominal interest rates of from five to eight percent, and had terms of 20 years or more.

These debt issues raised significant amounts of capital. A comparison of the 1905 and 1915 censuses indicates that firms located in Rio de Janeiro or the Distrito Federal, where the market well developed, financed 69 percent of their growth in total capitalization through the sale of new debt. For the country as a whole, 29 percent of new investment came in the form of long-term debt (See Table 3). In 1915 the average (weighted) debt equity ratio for firms in Rio de Janeiro or the Distrito Federal was .43:1.00, three times its level in 1905. For the country as a whole, the debt-equity ratio in 1915 was .27:1.00, nearly twice its level in 1905. (See Table 4).

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27 HABER, *Industry and Underdevelopment*, chapter 5.

28 MCGOULDRIK, *New England Textiles*.

**TABLE 3 - SOURCES OF NEW CAPITAL FOR BRAZILIAN COTTON  
TEXTILE FIRMS, 1905-1934**  
*Does Not Include Short Term Debt*

Period	Location	Firms	Growth of Total Capital	Share of New Paid Capital	Share of Long Term Debt	Share of New Reserves	Share of Capital Plus Reserves
1905-1915	All Brazil	174	88%	---	29,2%	---	70,8%
	Firms located in RJ or DF	30	45%	---	68,9%	---	31,1%
	Firms located in SP	43	272%	---	14,4%	---	85,6%
	Joint Stock Firms in RJ	25	55%	---	53,6%	---	46,4%
	Joint Stock Firms in SP	25	834%	---	13,5%	---	86,5%
	Joint Stock Firms in other States	12	208%	---	31,1%	---	68,9%
	Total Joint Stock Firms	62	135%	---	29,1%	---	70,9%
	Total Private Firms	112	35%	---	29,8%	---	70,2%
1915-1925	All Brazil	189	137%	37,5%	4,2%	58,3%	---
	Firms located in RJ or DF	28	118%	36,1%	3,5%	60,4%	---
	Firms located in SP	53	244%	39,2%	6,9%	53,9%	---
	Joint Stock Firms in RJ	25	136%	35,9%	6,5%	57,6%	---
	Joint Stock Firms in SP	33	270%	37,9%	7,0%	55,1%	---
	Joint Stock Firms in other States	20	109%	33,9%	1,1%	65,0%	---
	Total Joint Stock Firms	78	181%	36,9%	6,4%	56,7%	---
	Total Private Firms	111	54%	41,3%	-10,2%	68,9%	---
1925-1934	All Brazil	244	19%	80,3%	64,7%	-45,1%	---
	Firms located in RJ or DF	35	7%	67,4%	89,6%	-56,9%	---
	Firms located in SP	98	13%	127,1%	147,7%	-174,7%	---
	Joint Stock Firms in RJ	25	2%	18,2%	243,9%	-162,1%	---
	Joint Stock Firms in SP	31	1%	578,4%	2215,3%	-2693,7%	---
	Joint Stock Firms in other States	25	102%	65,9%	26,5%	7,6%	---
	Total Joint Stock Firms	81	9%	84,0%	158,7%	-142,7%	---
	Total Private Firms	163	56%	78,3%	12,2%	9,5%	---

Sources: Estimated from: Borja Castro, "Relatorio," p. 3-73; Comissão de Inquerito Industrial, Relatório; Branner, Cotton in the Empire of Brazil, Ministério da Indústria Viação e Obras Públicas, Relatório; Vasco, "Indústria de Algodão;" Centro Industrial do Brasil, O Brasil; Centro Industrial do Brasil, Relatório 1915; Centro Industrial do Brasil, O Centro Industrial; Centro Industrial de Fiação e Tecelagem, Relatório, 1924, 1925, 1926; Centro Industrial de Fiação e Tecelagem de Algodão, Estatísticas da Indústria; Centro Industrial de Fiação e Tecelagem, Fiação e Tecelagem; Stein, Brazilian Cotton, Appendix 1.

This analysis based on census data significantly understates the importance of debt financing, because it does not include trade debt from suppliers, short-term liabilities (mostly commercial paper), and the small quantity of mortgage debt owed to banks. For that reason, I have estimated financial ratios for the 15 firm sample of publicly owned companies from their balance sheets. In 1915 the average (weighted) debt-equity ratio for these 15 firms was .57:1.00 (see Table 2). The balance sheet data also corroborate the census data in regard to the pattern of bond finance: the use of the bond market was most important during the periods 1905-10, when new bond debt accounted for 29 percent of all new investment, and 1910-15, when new bond debt accounted for 45 percent of all new investment (See Panel II of Table 2).

TABLE 4 - FINANCIAL STRUCTURE OF BRAZILIAN COTTON TEXTILE FIRMS, 1905-1934  
Does Not Include Short Term Debt - (millions of current mil-réis)

Year	Location	Firms	Paid Capital	Long Term Debt	Reserves	Capital Plus Reserves	Total Capital	Debt Equity Ratio
1905	All Brazil	90	---	28	---	177	205	0,16
	Firms located in RJ or DF	19	---	13	---	93	106	0,14
	Firms located in SP	17	---	4	---	24	28	0,16
	Joint Stock Firms in RJ	17	---	13	---	77	91	0,17
	Joint Stock Firms in SP	3	---	4	---	6	10	0,68
	Joint Stock Firms in other States	4	---	---	---	7	8	0,06
	Total Joint Stock Firms	24	---	18	---	90	108	0,20
	Total Private Firms	66	---	11	---	87	97	0,12
	Joint Stock Firms as % Brazil		---	62,8%	---	51,1%	52,7%	
1915	All Brazil	174	264	81	41	305	386	0,27
	Firms located in RJ or DF	30	87	46	21	108	154	0,43
	Firms located in SP	43	79	15	8	88	103	0,17
	Joint Stock Firms in RJ	25	79	40	21	100	140	0,40
	Joint Stock Firms in SP	25	67	15	8	75	90	0,20
	Joint Stock Firms in other States	12	17	6	2	19	24	0,30
	Total Joint Stock Firms	62	163	60	31	194	255	0,31
	Total Private Firms	112	101	21	9	111	131	0,19
	Joint Stock Firms as % Brazil		61,6%	74,5%	76,8%	63,7%	65,9%	
1925	All Brazil	189	463	103	350	813	916	0,13
	Firms located in RJ or DF	28	152	52	131	284	336	0,18
	Firms located in SP	53	178	32	143	321	353	0,10
	Joint Stock Firms in RJ	25	148	52	131	279	331	0,19
	Joint Stock Firms in SP	33	159	32	142	300	332	0,11
	Joint Stock Firms in other States	20	26	6	19	45	51	0,13
	Total Joint Stock Firms	78	332	90	292	624	714	0,14
	Total Private Firms	111	130	14	58	188	202	0,07
	Joint Stock Firms as % Brazil		71,8%	86,9%	83,4%	76,8%	78,0%	
1934	All Brazil	244	605	218	271	875	1093	0,25
	Firms located in RJ or DF	35	168	73	118	286	359	0,25
	Firms located in SP	98	235	98	65	300	398	0,33
	Joint Stock Firms in RJ	25	149	73	118	267	340	0,27
	Joint Stock Firms in SP	31	176	98	61	237	335	0,42
	Joint Stock Firms in other States	25	60	20	23	84	103	0,24
	Total Joint Stock Firms	81	385	191	202	587	778	0,32
	Total Private Firms	163	219	27	69	288	315	0,10
	Joint Stock Firms as % Brazil		63,7%	87,4%	74,5%	67,1%	71,1%	

Source: Same as Table 3.

The use of long-term bond debt and the high percentages of capital coming from debt issues were quite remarkable by the standards of other countries. In the case of the early industrial United States debt played a minimal role. In 1860 the large-integrated textile manufacturers of New England typically had debt-equity ratios of .20:1.00—roughly one-third that of their large-scale Rio de Janeiro counterparts in 1915. All of this debt was short-term accounts payable and commercial paper.<sup>29</sup>

29 On the early industrial U.S. see DAVIS, "Sources;" MCGOULDRICK, *New England Textiles*.

As late as 1910, the average debt-equity ratio of large-scale firms in the United States textile industry (those listed in Moody's Industrials) was .40:1.00, roughly one-third lower than the debt-equity ratios for comparable Brazilian firms. Virtually all of the debt of U.S. firms, however, was short-term, long-term bonded debt being so scarce as to be non-existent.<sup>30</sup> Even by 1920, when a few of the largest U.S. firms began to issue long term bonds, the average debt-equity ratio was still .29:1.00. Most U.S. textile firms, of course, were not able to make use of the bond market and had to resort to the less-optimal option of issuing preferred shares when they wanted to grow faster than was possible through the reinvestment of retained earnings.<sup>31</sup>

Mexico, a country that was much closer to Brazil than the United States in terms of its level of industrial development, per capita income, and other features of its nineteenth century economic history, provides an even more striking comparison. Mexico's large, publicly-owned joint stock cotton textile companies (similar in many ways to the 15 Rio de Janeiro firms analyzed above) had an average ratio of debt to equity of .18:1.00 during the period 1900-1910, less than one-third of their Brazilian counterparts.<sup>32</sup>

Perhaps equally notable is the almost total absence of foreign direct investment in Brazil's textile industry. At their peak in 1915, foreign owned or foreign affiliated firms (broadly defined to include any firm in the census that listed any of its capital in foreign currency or any firm whose name indicated possible foreign participation) numbered only four and accounted for only 2.8 percent of installed capacity.

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30 Debt equity ratios calculated from *Moody's* 1900, 1910, and 1920.

31 Preferred shares are less favorable for firms than bonds because, like bonds, they carry the requirement of guaranteed interest payments, but at the same time they afford the firm much less flexibility. Unlike bondholders, preferred shareholders have the right to make claims on profits beyond the guaranteed interest rate. In addition, bonds are amortized, while preferred shares are not. Unless repurchased from shareholders, preferred shares require the payment of guaranteed returns to their holders in perpetuity. Finally, any such repurchase must be done at the market value of the shares, unlike callable bonds, which are repurchased at their par value. Since preferred shareholders have the right to a share of profits beyond the guaranteed interest rate, this means that the profitability of the firm becomes capitalized in their market value. Thus, almost by definition, a firm that has the ability to buy back its preferred shares is going to have to pay a price significantly above the par value of the shares to do so.

32 HABER, *Industry and Underdevelopment*, chapter five.

The absence of foreign investment in textiles is explained by three factors. First, Brazil did not have a comparative advantage in producing textiles and thus Brazilian firms sold all of their output domestically (behind a high tariff wall), and thus earned their revenues in Brazilian milréis. Brazil was not on the gold standard, and thus the milréis continually depreciated as silver lost value against gold. A foreign investor would therefore have seen the (gold-denominated) value of his assets decline. Perhaps equally important, foreign investors had no way of knowing which way the silver milréis was headed, thus creating uncertainty about the future value of assets.

Second, as a general rule foreigners tended to invest abroad only in those lines of economic activity where they had some distinct advantage over local entrepreneurs. When foreign entrepreneurs or corporations had knowledge of specialized technology that local capitalists did not, or where the scale of enterprise was larger than domestic financial markets could fund, foreign direct investment dominated the industry. Thus, foreign investment characterized industries such as railroading, electric power generation, and deep shaft mining. In the textile industry none of these factors came into play.

Third, the high tariff wall necessary to protect the industry against foreign competition imposed a high cost on Brazilian consumers, and by extension made it necessary for Brazilian industrialists to continually lobby the federal government to maintain their protection.<sup>33</sup> Overseas investors would have been poorly-placed politically to press the case for protection. Domestic industrialists, including foreign-born Brazilians, on the other hand, were an important political constituency and could therefore make the case for protection.

### III

The reform of the regulations governing the operation of the securities market had significant impacts on the growth in size, industrial structure, and productivity of the textile industry. The most obvious change in the industry was its size. As table 1 demonstrates, a small industry that appears to have been stagnating in the 1880's began to grow rapidly. Even according to the partial census of 1895, which seriously undercounted the industry's installed capacity, the industry had tripled in size since 1885. From 1895 to 1905 the industry tripled in size again, and then doubled from 1905 to 1915, making it the largest cotton textile industry of any

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33 For a history of the struggle by industrialists to obtain protective tariffs see VILELA LUZ, *Luta*.

Latin American country. It then grew an additional 70 percent up until 1927, when the depression cut short its growth.

This rapid rate of growth, it should be pointed out, was not confined to the cotton textile industry. According to Nathaniel Leff's estimates, real agricultural output increased from 1900 to 1909 by 3.5 percent per year, industrial output by 5.6 percent per year, and aggregate real output at a rate of 4.2 percent per year. From 1900 to 1947, the annual rate of growth of aggregate real output rose at 4.4 percent, while per capita real output grew by 2.3 percent per year. This impressive rate of aggregate growth was accompanied by a process of structural transformation in which industry came to be the fastest growing sector of the economy. Indeed, the period after 1900 marked the rapid expansion of a wide variety of manufacturing industries in Brazil, including steel, cement, glass, beer, food processing, and machine tools.<sup>34</sup>

This is not to argue that the only obstacle to growth prior to the 1890's was capital immobilities, and that the only relevant policy change in Brazil related to the regulation of financial markets. Coterminous with the reform of financial market regulations were increases in tariff protection and the expansion of the railroad network, which had begun to develop in the 1880's but which now grew rapidly under the combined influence of federal subsidies and the availability of foreign capital.<sup>35</sup> It is to argue, however, that one crucial piece of the puzzle explaining the lack of industrial development before 1890 and rapid industrial growth after 1890 was access to capital. Indeed, had problems in the mobility of capital not been an issue prior to 1890 it would be hard to explain the vast change in the way that firms used the securities markets to obtain their investment funds: the industry could simply have grown using the traditional sole proprietor and partnership forms of business organization.

There are two ways that we can at least partially control for these other changes in the Brazilian economy, thereby measuring *the marginal effects* of the capital market reforms. One is to look at firm size. Panel I of table 5 looks at 62 firms that appear in both the 1905 and 1915 censuses, segmenting them into five categories: private firms (partnerships or sole proprietorships), non-traded joint stock companies, publicly-traded joint stock companies, private-firms that switched to non-traded joint stock companies, and private firms that switched to publicly-traded joint

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34 LEFF, "Economic Development," p. 58. SUZIGAN, *Indústria Brasileira*.

35 On the impact of Brazil's inefficient railroad system see SUMMERHILL, "Transport Improvements." On the myriad problems constraining growth in nineteenth century Brazil see LEFF, *Underdevelopment and Development*; and LEFF, "Economic Development."



stock companies. Panel II of the same table repeats the operation, this time looking at 111 firms that appear in both the 1915 and 1925 censuses. The results of both panels are unambiguous. First, joint stock firms were anywhere from 2.5 to four times the size of private firms (the exact ratio depending on the year). Second, the rate of growth of new investment (as measured by spindlage) in joint stock companies was consistently faster than in private firms. Third, firms that switched from sole proprietorships or partnerships to publicly traded joint stock companies consistently grew faster than firms that did not switch. In fact, from 1905 to 1915 firms that private firms that became traded joint stock companies outgrew the other traded firms by three-to-one, and outgrew private firms by four-to-one. The implication is clear: privately-owned firms were capital constrained: their growth was limited by the rate at which they could plow back retained earnings or the rate at which their owners could divert their wealth from other sources into their textile mill. Limited liability, joint stock companies, on the other hand, were not as constrained. They could mobilize capital from a broad range of individual and institutional investors through a variety of financial instruments, including stocks, bonds, and commercial paper.

*TABLE 5 - GROWTH IN INSTALLED CAPACITY BY FIRM TYPE, 1905-1915 AND 1915-1925*

Panel I. Firms that appear in both the 1905 and 1915 censuses.						
Firm Type	Firms	Total Spindles in 1905	Total Spindles in 1915	Average Spindles Per Firm in 1905	Average Spindles Per Firm in 1915	Percent Change Average Firm Size
Private	41	291.334	402.824	7.283	9.825	35%
Non-Traded Joint Stock						
Traded Joint Stock	13	244.812	369.278	18.832	28.406	51%
Firms that switched:						
Private to Non-Traded Joint Stock	1	31.884	36.000	31.884	36.000	13%
Private to Traded Joint Stock	7	69.712	171.292	9.959	24.470	146%

  

Panel II. Firms that appear in both the 1915 and 1925 censuses.						
Firm Type	Firms	Total Spindles in 1915	Total Spindles in 1925	Average Spindles Per Firm in 1915	Average Spindles Per Firm in 1925	Percent Change Average Firm Size
Private	72	549.332	613.155	7.630	8.516	12%
Non-Traded Joint Stock	3	72.180	109.860	24.060	36.620	52%
Traded Joint Stock	32	634.292	1,001.784	19.822	31.306	58%
Firms that switched:						
Private to Non-Traded Joint Stock	3	28.900	36.108	9.633	12.036	25%
Private to Traded Joint Stock	1	7.000	10.000	7.000	10.000	43%

Source: Same as Table 1.

Brazilian industry would therefore have been smaller had there not been financial markets to mobilize capital - but how much smaller? One way to get a first-order approximation is to assume that the same number of firms would have existed, but that the publicly owned firms would have been as capital constrained as the privately owned firms. They therefore would have been the same size as privately owned firms. The total size of the industry in any year would therefore have been the actual number of firms censused multiplied by the average size of privately owned firms. Table 6 presents the results of these calculations. Had all firms been privately owned, in 1905 the industry would been 28 percent smaller, in 1915 32 percent smaller, and in 1925 49 percent smaller.

*TABLE 6 - AVERAGE CAPACITY BY FIRM TYPE, 1866-1934*

Year	Number of Firms				Average Number of Spindles			Industry Size		
	Total <sup>a</sup>	Private	Joint Stock Traded	Joint Stock Not Traded	Private	Joint Stock Traded	Joint Stock Not Traded	If All Firms Private	Actual	Difference
1866	9	9	0	0	1.653	--	--	14.875	14.875	0%
1875	11	11	0	0	4.166	--	--	45.830	45.830	0%
1881	24	22	2	0	2.513	14.830	--	60.323	84.956	29%
1883	24	22	2	0	2.428	12.750	--	58.264	78.908	26%
1905	90	72	16	2	6.210	11.932	20.270	558.900	778.224	28%
1907	117	95	21	1	4.790	15.758	37.340	560.430	823.343	32%
1914	204	152	49	3	5.495	16.608	6.346	1.120.980	1.634.449	31%
1915	170	120	45	5	6.355	16.701	16.874	1.080.350	1.598.568	32%
1924	184	132	42	10	6.610	31.320	17.685	1.216.240	2.200.612	45%
1925	183	122	44	17	6.720	30.010	15.120	1.229.760	2.397.380	49%
1926	214	141	50	23	6.391	26.578	14.594	1.367.674	2.558.433	47%
1927	228	146	48	34	6.702	27.820	11.126	1.528.056	2.692.007	43%
1934	203	131	41	31	7.491	26.828	13.739	1.520.673	2.507.126	39%

<sup>a</sup> Includes only those firms with spindles data.

Source: Same as Table 1.

One might argue that the absence of joint stock limited liability companies would have opened up the possibility for investments in the industry by existing and potential private firms, and thus the industry would not in fact have been any smaller. Doubtless this would have happened. The implication, however, is that these potential firms would have been less efficient than joint stock firms they would have replaced, otherwise they would have come into existence anyway and out-competed the joint stock companies. Either way there would have been a loss for Brazil: a smaller, but equally efficient industry; or a less efficient, but equal sized industry. We will return to this latter possibility in some detail shortly.

The second way to control for factors other than the capital market reforms would be a counterfactual exercise comparing Brazil with another late industrializing country that had similar tariff reforms and railroad building programs. Mexico is a

such a case.<sup>36</sup> Mexico did not, however, undertake the kinds of financial market regulatory reforms that Brazil did, and where its legal reforms did mirror those of Brazil it did not enforce the new laws. The result was that the Mexican textile industry grew slowly. In the early 1880's the Mexican cotton textile industry was three times the size of Brazil's. By 1907 the industries were roughly the same size, and by circa 1915, Brazil's industry was twice the size of Mexico's, even though Mexican and Brazilian national incomes were roughly equal.<sup>37</sup>

The second impact of the institutional reforms that allowed for the creation of limited liability, joint stock companies in Brazil was an increase productivity: joint-stock firms were more efficient than those that were privately owned. These results are indicated by estimates of Cobb-Douglas Production Functions on the panel data set and by estimates of firm level total factor productivity (TFP) derived from those production functions. Let us first look at TFP across each census where we have sufficient observations to estimate mean TFP by firm type, and then turn to multivariate regression analysis to decompose the differences between firm types.

Tables 7 and 8 present estimates of mean (weighted by firm size) factor productivity by firm type and size covering the years 1866 to 1927. We measure output two ways, by real value and by physical units (meters of cloth). Each measure of output has its advantages and disadvantages: real output is sensitive to the price index we construct to measure changes in the price of cloth; physical output eliminates the price index problem, but understates output because it cannot capture differences in the quality composition of cloth over time (which was significant).

The real value estimates require first the estimation of a price index for cotton textile goods. We assume that Brazilian manufacturers priced their products at the milreis price of foreign imports plus the tariff. It then follows from that the rate of change of domestic prices is equal to the sum of the changes in the nominal exchange rate, the tariff, and the value of foreign cotton goods. Since most Brazilian imports were from Great Britain, we employ the British cotton goods price series.

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36 GRAHAM CLARK, *Cotton Goods*, p. 38.

37 HABER, "Financial Markets".

TABLE 7 - AVERAGE TOTAL FACTOR PRODUCTIVITY (IN REAL VALUE OF OUTPUT) BY FIRM TYPE AND SIZE, BRAZILIAN COTTON TEXTILE INDUSTRY, 1907-1927

TFP Estimated using normalized Capital and Labor Weights from Production Functions Reported in Table 9 (Weighted by Firm Size)  
Output Proxied by Real Value of Production (1913 Mil-réis)

Year	Firm Sizes	Reporting Firms			Average Output Per Worker			Average Output Per Spindle			Average Spindles Per Worker			Average Total Factor Productivity			Average TFP All Firms
		JS	Private	Total	JS	Private	Diff.	JS	Private	Diff.	JS	Private	Diff.	JS	Private	Diff.	
1907	Total	18	52	70	3.656	2.503	46%	150	153	-2%	24	16	49%	1.194	941	27%	1.053
	< 13,500	9	49	58	3.152	2.497	26%	232	169	37%	14	15	-8%	1.264	974	30%	1.028
	>13,500	8	3	11	3.847	2.545	51%	135	91	48%	29	28	2%	1.190	794	50%	1.117
	America Fabril	1		1	3.030			145			21			1.045			
1914	Total	39	84	123	3.856	2.895	33%	153	135	13%	25	21	18%	1.246	991	26%	1.109
	< 13,500	21	75	96	2.970	2.868	4%	151	156	-3%	20	18	6%	1.048	1.034	1%	1.038
	>13,500	17	9	26	4.246	2.948	44%	153	109	41%	28	27	2%	1.327	928	43%	1.180
	America Fabril	1		1	3.896			141			28			1.218			
1915	Total	41	98	139	3.945	2.945	34%	167	164	2%	24	18	31%	1.305	1.071	22%	1.175
	< 13,500	22	88	110	3.805	2.812	35%	203	174	17%	19	16	16%	1.364	1.061	29%	1.133
	>13,500	18	10	28	3.997	3.257	23%	158	147	7%	25	22	14%	1.289	1.100	17%	1.224
	America Fabril	1		1	3.871			141			28			1.213			
1924	Total	50	111	161	7.996	5.889	36%	382	363	5%	21	16	29%	2.759	2.222	24%	2.759
	< 13,500	29	95	124	7.216	6.532	10%	454	452	0%	16	14	10%	2.740	2.566	7%	2.616
	>13,500	20	16	36	8.277	4.762	74%	364	247	48%	23	19	18%	2.775	1.690	64%	2.419
	America Fabril	1		1	8.769			214			41			2.391			
1925	Total	57	98	155	10.498	6.859	53%	472	430	10%	22	16	39%	3.546	2.603	36%	3.127
	< 13,500	36	85	121	10.398	7.149	45%	604	507	19%	17	14	22%	3.840	2.832	36%	3.191
	>13,500	20	13	33	10.542	6.240	69%	431	314	37%	24	20	23%	3.444	2.192	57%	3.103
	America Fabril	1		1	7.770			214			36			2.210			
1926	Total	65	104	169	8.918	6.890	29%	433	415	4%	21	17	24%	3.094	2.577	20%	2.872
	< 13,500	39	88	127	9.288	6.911	34%	534	452	18%	17	15	14%	3.418	2.660	28%	2.943
	>13,500	25	16	41	8.782	6.860	28%	404	370	9%	22	19	17%	2.988	2.468	21%	2.835
	America Fabril	1		1	7.214			176			41			1.966			
1927	Total	73	110	183	8.571	6.499	32%	385	374	3%	22	17	28%	2.894	2.393	21%	2.675
	< 13,500	45	93	138	8.439	6.711	26%	496	428	16%	17	16	8%	3.130	2.560	22%	2.779
	>13,500	27	17	44	8.621	6.235	38%	356	321	11%	24	19	25%	2.825	2.207	28%	2.626
	America Fabril	1		1	6.429			157			41			1.752			

Source: See Table 1.

**TABLE 8 - AVERAGE TOTAL FACTOR PRODUCTIVITY (IN PHYSICAL VOLUME) BY FIRM TYPE AND SIZE, BRAZILIAN COTTON TEXTILE INDUSTRY, 1905-1927**  
*TFP Estimated using normalized Capital and Labor Weights from Production Functions Reported in Table 9 (Weighted by Firm Size) - Output Proxied by Meters of Cloth*

Year	Firm Sizes	Reporting Firms			Average Output per Worker			Average Output per Spindle			Average Spindles per Worker			Average Total Factor Productivity			Average TFP All Firms
		JS	Private	Total	JS	Private	Diff.	JS	Private	Diff.	JS	Private	Diff.	JS	Private	Diff.	
1905	Total	16	48	63	8.957	6.875	30%	375	387	-3%	24	18	35%	3.045	2.586	18%	2.780
	< 13,500	8	43	51	6.882	6.109	13%	481	403	19%	14	15	-5%	2.784	2.425	15%	2.503
	>13,500	7	5	12	9.814	8.869	11%	353	362	-3%	28	25	14%	3.167	2.989	6%	3.104
	America Fabril	1			7.576			361			21			2.692			
1907	Total	18	51	68	9.138	5.499	66%	374	340	10%	24	16	51%	3.083	2.134	44%	2.562
	< 13,500	9	48	57	8.098	5.319	52%	595	366	62%	14	15	-6%	3.333	2.142	56%	2.366
	>13,500	8	3	11	9.533	6.764	41%	334	242	38%	29	28	2%	3.050	2.181	40%	2.890
	America Fabril	1			7.576			361			21			2.692			
1924	Total	49	107	155	6.088	5.973	2%	313	365	-14%	16	19%		2.309	-4%		2.262
	< 13,500	29	91	120	5.736	5.890	-3%	361	404	-11%	19	15	9%	2.220	2.368	-5%	2.328
	>13,500	19	16	35	6.216	6.111	2%	300	317	-5%	16	19	7%	2.239	2.234	244%	2.223
	America Fabril	1			4.571			111			21			7.686			
1925	Total	57	96	152	6.208	5.941	4%	282	367	-23%	22	16	36%	2.170	2.305	-6%	2.223
	< 13,500	35	83	118	6.141	5.587	10%	359	386	-7%	17	14	18%	2.339	2.252	4%	2.281
	>13,500	21	13	34	6.235	6.637	-6%	260	338	-23%	24	20	22%	2.116	2.413	-12%	2.195
	America Fabril	1			4.069			112			36			1.199			
1926	Total	61	91	151	6.183	5.763	7%	303	341	-11%	20	17	21%	2.218	2.204	1%	2.210
	< 13,500	36	78	114	6.200	5.976	4%	366	382	-4%	17	16	8%	2.369	2.345	1%	2.354
	>13,500	24	13	37	6.177	5.474	13%	286	295	-3%	22	19	17%	2.172	2.028	7%	2.129
	America Fabril	1			4.571			111			41			1.293			
1927	Total	71	92	162	6.088	5.890	3%	277	334	-17%	22	18	25%	2.128	2.221	-4%	2.164
	< 13,500	45	74	119	5.864	5.728	2%	356	365	-2%	16	16	5%	2.263	2.247	1%	2.254
	>13,500	25	18	43	6.182	6.062	2%	254	308	-18%	24	20	24%	2.088	2.201	-5%	2.124
	America Fabril	1			4.008			98			41			1.134			

Source: See Table 1.

We then estimate TFP by combining the capital and labor inputs using weights from the first specification of the production functions presented in Table 9 (normalizing the capital and labor coefficients to one).<sup>38</sup> Following Kane's work on the United States, we employ the number of spindles as a proxy for the capital input of each company.<sup>39</sup> Following Attack and Sokoloff on productivity in the United States, and of Bernard and Jones on international productivity comparisons, we employed the number of workers as the measure of the labour input.<sup>40</sup>

The estimates presented here break firms into two categories, joint stock and privately owned, and into two sizes, those smaller than 13,500 spindles and those larger than 13,500 spindles. This size was chosen as the break point because 13,500 spindles was the median firm size observed in the panel data set. Conveniently, it also represents a firm size equivalent to a capacity share of 0.5 percent at the time of the last census under analysis. As we shall see later on, when we use survivor methods to cross check our TFP regressions, 0.5 percent turns out to be the minimum efficient scale of production. The results for one public firm, the Companhia América Fabril, are reported separately. This firm controlled roughly 12 percent of the industry's capacity, and 26 percent of the capacity of joint stock firms. Because the estimates presented here are weighted averages, the inclusion of this firm can potentially drive the results. Note that the number of firms analyzed here does not correspond to the total number of firms in the industry in any given year. Only those firms which reported all the necessary variables to estimate TFP are included.

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38 When output is measured in real values, this produces capital and labor weights of .35 and .65, respectively. When output is measured in physical units (meters of cloth) this produces capital and labor weights of .34 and .66.

39 See, for instance, KANE (1988).

40 See ATTACK, *Estimation of Economies of Scale in Nineteenth Century United States Manufacturing* (New York and London, 1985); SOKOLOFF, 'Was the Transition from the Artisanal Shop to the Nonmechanized Factory Associated with Gains in Efficiency? Evidence from the U.S. Manufacturing Censuses of 1820 and 1850', *Explorations in Economic History*, v. 21, n. 4 (1984), p. 351-82; and BERNARD AND JONES, 'Productivity across Industries and Countries: Time Series Theory and Evidence', *The Review of Economics and Statistics*, v. 78, n. 1 (1996), p. 135-146.

**TABLE 9- ALTERNATE SPECIFICATIONS OF COBB-DOUGLAS  
PRODUCTION FUNCTIONS**  
*Brazilian Cotton Textile Industry, 1905-1927 - Unbalanced Panel  
 Regressions on Entire Sample - Total Ordinary Least Squares - T Statistics in  
 Parentheses*

Dependent Variable:	Log(Real Value of Production/Worker) <sup>a</sup>					Log(Meters of Output/Worker) <sup>b</sup>				
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7	Spec 8	Spec 9	Spec 10
1) Intercept	6,502 (39,678)	6,389 (38,909)	6,268 (38,652)	6,154 (40,351)	6,256 (37,689)	8,240 (48,685)	8,290 (49,408)	8,162 (49,651)	8,077 (51,001)	8,181 (46,686)
2) Ln(Spindles/Worker) - proxy for capital	0,316 (8,765)	0,331 (9,100)	0,348 (9,603)	0,304 (8,607)	0,298 (8,336)	0,307 (7,236)	0,301 (7,145)	0,322 (7,710)	0,299 (7,077)	0,289 (6,732)
3) Ln(Workers) - proxy for firm size	-0,012 (-0,613)	0,002 (0,088)	0,018 (0,985)	0,034 (1,958)	0,019 (0,978)	-0,060 (-3,094)	-0,068 (-3,493)	-0,052 (-2,731)	-0,039 (-2,916)	-0,051 (-2,529)
4) Time	0,061 (21,310)	0,062 (21,545)	0,063 (21,376)	0,061 (21,627)	0,061 (21,435)	-0,008 (-3,103)	-0,008 (-3,012)	-0,007 (-2,921)	-0,007 (-2,916)	-0,007 (-2,953)
5) Vintage-Dummy for firms founded on or after 1905	0,076 (2,037)	0,089 (2,344)	0,087 (2,284)	0,065 (1,756)	0,059 (1,583)	0,019 (0,475)	0,030 (0,755)	0,025 (0,625)	0,016 (0,421)	0,020 (0,500)
6) Joint Stock - Dummy for Limited Liability Joint Stock Company	0,226 (5,770)					0,096 (2,432)				
A) Joint Stock Out - Dummy for Joint Stock Firm outside of competitive region					0,285 (2,248)					-0,052 (-0,459)
7) Traded-dummy for firms listed in stock exchange markets		0,165 (3,872)					0,147 (3,447)			
8) Bonds - Dummy for Bonded Debt			0,093 (1,842)					0,080 (1,566)		
9) Region - Dummy for Firms in MG, RJ, DF, SP				0,300 (8,281)					0,126 (3,323)	
A) Privately-Owned in MG, RJ, DF, SP					0,279 (6,394)					0,088 (1,922)
B) Joint Stock in MG, RJ, DF, SP					0,354 (8,138)					0,153 (3,389)
N	1017	1017	1017	1017	1017	785	785	785	785	785
Adjusted R <sup>2</sup>	0,40	0,39	0,39	0,42	0,43	0,09	0,10	0,09	0,10	0,10

<sup>a</sup> Sample runs from 1907 thru 1927.

<sup>b</sup> Sample runs from 1905 thru 1927.

Source: See Table 1.



A number of features of the data are immediately obvious. The first, as table 7 indicates, is that average output per worker is anywhere from 29 to 53 percent higher in joint-stock firms. This relationship holds across time and across size categories. The reason for this difference in labor productivity is not hard to fathom when one looks at a second feature of the data: the capital-labor ratio. On average, joint stock firms had anywhere from 18 to 49 percent (depending on the year) more spindles per worker than their privately owned competitors, owing, no doubt, to the lower cost at which they could obtain capital. Not surprisingly, large joint stock firms appear to have been the most capital intense. The third striking feature of the data is the sizable differences in TFP across firm type: the weighted mean of TFP for all joint stock firms was anywhere from 20 to 36 percent higher than for all privately owned firms.

In Table 8 we estimate TFP using the same procedures employed in Table 7, but we substitute meters of cloth as the proxy for output in the TFP calculations. We obtain results that are dissimilar from those we obtained when we measured output by its real value. First, the gap in average output per worker between firm types disappears in the 1920's. Second, average output per spindle is much lower in joint stock companies than in privately owned companies in the 1920's. Third, on average, there is little difference in TFP between private and joint stock firms in the 1920's. Fourth, average TFP estimates indicate no productivity growth at all in this industry from 1905 to 1927, which is difficult to reconcile with the fact that the industry was expanding rapidly. It is also difficult to reconcile with the rapid TFP growth when we proxy output by the real value of production. (see Table 7). The most reasonable interpretation is that joint stock firms in the 1920's were moving into the production of small runs of high-value products, while private firms tended to continue the old practice of producing large volumes of low quality cloth. We will return to this issue, shortly, when we turn to multivariate analysis.

In order to decompose these differences in factor productivity by firm type and size, and to measure the impact of access to low cost capital from the securities markets *on the margin*, we turn to multivariate regression analysis. We used an unbalanced panel procedure to estimate basic pooled and fixed-effects specifications of regressions for the years 1905-1927 of the following type:

$$Y_{it} = \alpha + \beta \times X_{it} + u_{it}$$

where  $Y_{it}$  is the dependent variable of firm  $i$  at time  $t$ ;  $\alpha$  is the overall intercept term for all firms;  $\beta$  is a vector of coefficients corresponding to the  $X_{it}$  vector of

independent variables and  $\mathbf{u}_{it}$  is a stochastic term.<sup>41</sup> We assume usual normality and independence conditions to obtain least-squares estimates of  $\beta$ .<sup>42</sup>

We assume a Cobb-Douglas production function of the form  $Y = A \times K^\gamma \times L^{1-\gamma}$  with constant returns to scale where  $K$  and  $L$  represent the capital and labor inputs and  $A$  is a function that captures improvements in technology over time. In order to use linear estimation procedures, we take natural logarithms of a normalised production function of the form  $y = k^\alpha$  where  $y = Y/L$  and  $k = K/L$  and add explanatory variables to arrive at the following model.

$$\ln y = \alpha + \beta_1 \times \ln k + \beta_2 \times \ln L + \beta_3 \times \text{Time Trend} + \delta \times \text{dummies}$$

This specification allows us to both test for economies of scale as well as to obtain the rate of total factor productivity growth, the coefficient on the Time Trend. We use variations of this equation to estimate the impact of other features of firms (location, traded status, vintage, and other relevant variables) for the specifications whose results are reported in Table 9.<sup>43</sup>

41 For OLS estimates, this coefficient would be the same for all firms; for fixed effects, it was not estimated as it was allowed to vary freely among cross-sections. Both models, the basic pooled and fixed effects produced the same qualitative results with minor differences in the magnitude of the estimated coefficients. In some cases, as with the time trend, the estimates were nearly identical. Thus, to avoid repetition, we report only results from the basic pooled model.

42 In the construction of time series for each observation units, it is evident that plain OLS techniques would result in biased estimates because some of the variables in latter periods could be predicted from earlier years (e.g., spindles at time  $t$  could very well be equal to spindles at time  $t+1$ ). The panel procedure individually identifies each company over time to correct for potential autocorrelation in its variables.

43 This specification provides a simple test for economies of scale, following the methodology of ATACK, *Estimation of Economies of Scale*. The sign of  $\beta_2$  would indicate whether, if negative, there are decreasing returns to scale or, if positive, increasing returns to scale. The magnitude of  $\beta_2$  would indicate the level to which production deviates from the standard case of constant returns to scale. A coefficient of small magnitude, that is not statistically significant, would corroborate the hypothesis of constant returns to scale. The additional variables, *Dummies* and *Interaction Terms*, are vectors of dummy explanatory variables (including limited liability status, trading in the stock market, and location in the central region), respectively;  $\delta$  and  $\gamma$  are correspondingly the coefficient vectors. We use these to further decompose the rate of growth ( $\beta_3$ ) of TFP. We obtain the same results if we used a specification where the variables were not normalised by the labour input but in that case we would not be able to test for economies of scale. Whether or not we normalise by labour,  $\beta_3$  remains the rate of total factor productivity growth because in both cases, the contribution of the two inputs would have been accounted by the estimates of  $\beta_1$  and  $\beta_2$ .

Specification 1 of Table 9 indicates that, as predicted, there were negligible scale economies in the Brazilian cotton textile industry (the coefficient on firm size is negative, of small magnitude, and is not statistically significant). The industry was, however, characterized by rapid productivity growth: the time trend was 6.1 percent per year. As expected, newer firms (those founded after 1905) had higher productivities than their older competitors (the coefficient translates into roughly an 8 percent TFP advantage for newer firms, everything else being equal).<sup>44</sup> Perhaps most striking is the sizable impact of the joint stock corporate form. The coefficient of .226 on the joint stock dummy translates into a 25 percent TFP advantage over non-joint stock firms.

One might think that firms that were actively traded on an organized exchange might have been more efficient than joint stock firms that were not traded. The notion is that firms that were regularly traded were monitored more closely by large investors. Ideally, we would add a traded dummy to specification 1, to measure the *marginal impact* of being publicly traded. Traded firms were, however, a subset of joint stock firms, meaning that there is collinearity between the two variables. We therefore estimate the impact of being traded in specification 2 by substituting a traded dummy for the joint stock dummy. We are able to reject the hypothesis that traded status explains the advantage that joint stock firms had over their competitors: the coefficient is large and statistically significant, but it is of a smaller magnitude than that on joint stock firms alone. It may have been the case that the secondary markets for equity were too thin to serve as efficient monitors. Or, it may be the case that some of the most productive joint stock companies' shares were closely held by their original investors.

What was the impact of being able to issue bonds on productivity growth? One view would hold that there should be a positive correlation between being able to sell debt and higher levels and rates of growth of productivity. In this view, firms that have established track records for being well managed will be the most likely to succeed in selling debt to the investing public. In turn, this reduces their cost of capital and further increases their growth of productivity. An alternative view, associated with Brander and Spencer, is that if an owner-manager substitutes borrowed funds for equity, then the effort of the owner declines and the firm's output falls. The reason for this is that bondholders have less incentive than equity holders to monitor managers.<sup>45</sup> Specification 3 tests these hypotheses by introducing a dummy variable for firms whose bonds were traded on either the

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44 Intercept coefficients can be translated into percentages through the following formula:  $\beta_1 \cdot 1$ .

45 BRANDER AND SPENCER, "Moral Hazard," p. 833-849.

Rio de Janeiro or São Paulo exchanges. The magnitude of the coefficient is much smaller than that for being a joint stock company, indicating that while firms that issued bonds were roughly 10 percent more productive than the average firm, they were less efficient than joint stock firms as a group.

One might argue that the differences in TFP between joint stock and privately-owned firms are due purely to regional productivity differences. Perhaps it was the case that all of the low TFP firms were located in isolated markets where transport barriers protected them from competition. Specifications 4 and 5 test this hypothesis. Specification four introduces a dummy variable for firms located in the highly integrated, rapidly growing, four-state market of Rio de Janeiro, the Distrito Federal, Minas Gerais, and São Paulo. The coefficient on region (.300) indicates that there were in fact sizable regional productivity differences. Specification 5 decomposes the effects of region and joint stock status by introducing dummy variables for joint stock firms located outside of the competitive region, joint stock firms located in the region, and all other firms in the region.<sup>46</sup> The results indicate that even if we control for regional effects, there was still a positive residual for firms that took the joint stock form (note that the coefficient in 9B is of greater magnitude than 9A, and both are significant at the one percent level). The regressions also indicate that joint stock firms outside of the competitive region also had a sizable productivity advantage against their privately-owned competitors. The coefficient of .285 (Line 6A, Specification 5) translates into a 33 percent productivity differential.

What advantage was conferred on joint stock firms that created such sizable productivity differences? Table 8 indicated that joint stock firms had higher capital-labor ratios, owing, no doubt, to the relative ease with which they could raise capital. One might imagine that this might have either allowed them to produce more cloth per worker, or it might have allowed them to specialize in high value cloth, whose production required more capital-intensive techniques. Panel II of Table 9 tests these hypotheses by substituting the volume of cloth produced (in meters) for the real value of output (Specifications 6, 7, 8, 9, and 10 mirror specifications 1-5, except that the proxy for output changes). With the exception of the time trend, the qualitative results of the relationship between vintage, region, capital-labor ratio, firm size, joint stock status, and other relevant variables are similar to those obtained when we proxied output by real value. Joint stock firms were more productive than their private competitors. While there are a number of

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46 The fact that virtually all of the joint stock companies were located in the four state region means that these variables are likely to be collinear. Thus, we cannot simultaneously introduce dummy variables for region and joint stock to measure the marginal impact of being traded taking region into account.

minor differences between the results in the two panels (such as the stronger impact of being publicly-traded when output is proxied by volume), the only glaring difference is that when output is proxied by meters of cloth the time trend is negative. Thus, we can reject the hypothesis that joint stock firms were able to produce more cloth per input than their private competitors.

The most reasonable interpretation of the variance of the time trend across the two panels is that joint stock firms tended to produce more fine-weave, high quality goods than private firms. Generally speaking, the production of such cloth requires that machines be run more slowly, because fine yarns are more subject to breakage. The result is that firms need to purchase larger numbers of machines to produce the same volume of cloth, resulting in more machines per worker than in firms that produce low-value cloth. These results are consistent with information on the value of various types of output in the 1907 and 1915 censuses. The census data indicates that joint stock firms tended to produce more high value goods than their private counterparts.

A skeptical reader might respond that the use of physical inputs of capital and labor in the production functions means that while public firms might have been more technically efficient, they were not necessarily more economically efficient. It might have been the case, for example, that the different techniques of production between joint stock and private firms meant that joint stock firms actually had higher unit costs because they had to purchase more expensive skilled labor or because they had to purchase more expensive types of raw cotton. Stigler's survivor method allows us to test this hypothesis. In a competitive market the most economically efficient firms survive, while those firms that are economically inefficient go out of business. Firm types or firm sizes that are inefficient will therefore grow more slowly than firm types or sizes that are efficient.

A glance at Table 10 demonstrates that the fastest growing type of firm was limited liability joint stock companies, and the fastest growing size category was small firms (capacity shares of less than 0.5 percent). Fastest growing of all were small joint stock firms. Over the 30 years from 1905 to 1934, the number of joint stock limited liability companies more than tripled, while the number of private firms did not even double. The number of small joint stock firms grew nearly five-fold (from 8 in 1905 to 47 in 1934). These results corroborate the findings in Tables 7, 8, and 9 that scale economies were exhausted at small firm sizes. They also corroborate the findings that joint stock companies, regardless of size, were more efficient than private firms. In short, technical efficiency and economic efficiency were one and the same in the case under study.

Table 10 - SURVIVORSHIP, BY CAPACITY AND FIRM TYPE, 1895-1934

	Number of Firms			Percent of Firms		
	Joint Stock	Private	Total	Joint Stock	Private	Total
1905 Share of Capacity						
<.5%	8	33	41	9%	37%	46%
.5-1.00%	3	15	18	3%	17%	20%
1.01-3.00%	6	15	21	7%	17%	23%
3.01-5.00%	6	3	9	7%	3%	10%
>5.01%	1	0	1	1%	0%	1%
Total	24	66	90	27%	73%	100%
1915 Share of Capacity						
<.5%	23	87	110	14%	51%	65%
.5-1.00%	19	16	35	11%	9%	21%
1.01-3.00%	16	5	21	9%	3%	12%
3.01-5.00%	2	1	3	1%	1%	2%
>5.01%	1	0	1	1%	0%	1%
Total	61	109	170	36%	64%	100%
1925 Share of Capacity						
<.5%	44	96	140	24%	52%	77%
.5-1.00%	10	8	18	5%	4%	10%
1.01-3.00%	16	5	21	9%	3%	11%
3.01-5.00%	3	0	3	2%	0%	2%
>5.01%	1	0	1	1%	0%	1%
Total	74	109	183	40%	60%	100%
1934 Share of Capacity						
<.5%	47	105	152	23%	52%	75%
.5-1.00%	11	13	24	5%	6%	12%
1.01-3.00%	20	5	25	10%	2%	12%
3.01-5.00%	1	0	1	0%	0%	0%
>5.01%	1	0	1	0%	0%	0%
Total	80	123	203	39%	61%	100%

Sources: Same as Table 1.

#### IV - CONCLUSIONS AND IMPLICATIONS

Changes in the regulations governing financial markets in Brazil allowed the capital markets to function more smoothly. It was not just that it was difficult to form a joint stock company. Indeed, even after these restrictions were removed in 1882 capital did not quickly flow into the textile industry. Nor did legal restrictions on the operation of banks turn out to be important. Even after restrictions on the operations of banks were removed in 1890 there was little long-term investment by banks in the textile industry. Rather, the most important reforms were those related to limited liability and mandatory disclosure. These reforms lowered the costs of monitoring managers and eliminated the need for shareholders to monitor one another. This allowed entrepreneurs to mobilize capital from beyond their founding kinship and business groups. Indeed, secondary markets developed in Rio de Janeiro and Sao Paulo that made this investments liquid.

These institutional changes meant that many firms (and potential firms) were no longer capital constrained. Not every firm could tap the capital markets, because it was necessary to either have a well established reputation or have access to an intermediary who could signal investors that a firm was a good investment. It was the case, however, that large numbers of firms were able to adopt take advantage of the joint stock, limited liability form and mobilize capital from beyond their founding groups. The fall in the cost of capital meant that those firms had more flexibility in their choice of the capital-labor ratio. The result was an increase in the size of the industry and an increase in the rate of growth of productivity.

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