THE EFFICIENCY CONSEQUENCES OF INSTITUTIONAL CHANGE: FINANCIAL MARKET REGULATION AND INDUSTRIAL PRODUCTIVITY GROWTH IN BRAZIL, 1866-1934

Stephen Haber

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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. This analysis is based on panel data regressions on 18 firm-level censuses covering the period 1866-1934, which permit me to decompose total factor productivity growth. These censuses cover both limited liability joint stock corporations as well as privately owned firms. I also analyze corporate financial statements and stock market data for publicly held firms covering the period 1895-1940. 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 1890s were relaxed. The result was an increased rate of investment, a decline in industrial concentration, and accelerated rates of growth of productivity.

Stephen Haber
School of Humanities and Sciences
Stanford University
Building 1
Stanford, CA 94305-2070
and NBER
haber@leland.stanford.edu

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.[1]

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, as this approach has come to be called, 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

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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 Avner Greif, "Micro Theory."

not impossible, to use the history of developed countries as a laboratory to assess the impact of institutional reforms.[2] 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, 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 (thereby avoiding the problems of the market anticipating institutional change and the endogeneity of institutional change), and where there is sufficient quantitative data available to measure the productivity consequences of institutional change.[3] What this fundamentally means is that 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.[4]

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[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."

[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

I focus on the case of Brazil during the period 1866-1934 for the following reasons. First, in late nineteenth century Brazil there was a big discontinuity in the regulation of the financial markets brought about by exogenous political changes--namely the overthrow of the monarch in 1889 and the founding of a federal republic. Indeed, 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 new government engaged in 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--for both privately-owned and publicly-held companies--that permits the estimation of productivity growth over a long period of time. It is therefore possible in the Brazilian case to actually see what impact the opening of the securities markets had on the efficiency of industry by systematically analyzing differences in the absolute levels and rates of growth of 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. The resulting time-series, cross-sectional regressions permit

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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."

me to dynamically measure the effects of access to capital from the securities markets on total factor productivity, controlling for the effects of region, vintage of capital, and other relevant variables.

I argue that changes in government regulations had a profound effect on the growth and performance of industry. The eight years from 1882 to 1890 witnessed a variety of reforms that permitted trading on margin, that permitted banks to engage in whatever types of investments they wished, and that eased the rules under which joint stock companies could be formed. What was especially crucial, however, were two particular reforms, both of which occurred in the first few months after the creation of the new government in 1890. The first was the establishment of limited liability. Essentially this 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 (which, as we shall see, many did aggressively) 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 upshot was that firms were able to use both avenues of finance. It is important to note that changes in the rules by which companies received charters did not seem to matter very much: the 1882 reforms that made corporate chartering an administrative rather than a legislative procedure had little effect on the use of the market as a source of finance. Without limited liability the ability to legally found a joint stock company did little to overcome the resistance of both entrepreneurs and investors to use the securities markets.

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. This information was printed in monthly consolidated stock and bond tables in the major newspapers, making comparisons between firms easy.

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.[5] First, mandatory disclosure made it easier for investors to monitor managers. Second, as Carr and Mathewson have shown, 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.[6] 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

[5] For reasons of ease of exposition, throughout this paper I use the terms limited liability joint stock company, publicly held company, or public company interchangeably.

[6] See Carr and Mathewson, "Unlimited Liability," pp. 766-784.

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 publicly-held 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 publicly held firms could take advantage of economies of scale in production. In fact, the firms with the highest TFP were small publicly-owned firms, whose market shares were typically less than one-half of one percent of total industry capacity. 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 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 go public. 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 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, concentration, 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. As Table 1 demonstrates, textiles never accounted for more than eight percent of the common stock of business enterprises traded on the Rio de Janeiro and Sao Paulo exchanges. If we include the debt markets as well, which were dominated by government bond issues, textile enterprises would have accounted for an even smaller percent of activity still.

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.[7] Second, both the Brazilian government and Brazil's various manufacturers' associations regularly gathered systematic census-type data, enumerated at the firm level, 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 between privately and publicly-owned firms 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. The textile industry therefore provides a relevant test case of the proposition that regulatory reforms that ease capital constraints on firms has an impact on their efficiency.[8]

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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*, pp.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. This financial information includes the firm's paid-in capital, reserves, and outstanding long-term debt. 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.[9] 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.[10] 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

[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 Sao 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*.

15 firms are not a random sample, but were chosen because it was possible to retrieve complete sets of their financial statements.[11] 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-owned firms. These financial statements permit, however, the more detailed study of the structure of debt and equity than do the censuses because the financial reports include information about short-term debt. Finally, some of the financial statements that I have retrieved include data on the names and share positions of all stockholders, permitting me to study the dispersion of ownership of these firms.

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 and equity of nearby cotton mills.[12] No data has been retrieved on these smaller markets.

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[11] The 15 firms are: Companhia de Fiaçao e Tecidos Alliança, Companhia America Fabril, Companhia Brasil Industrial, Companhia de Fiaçao e Tecelagem Carioca, Companhia de Fiaçao e Tecidos Industrial Campista, Companhia de Fiaçao e Tecidos Cometa, Companhia de Fiaçao e Tecidos Confiança Industrial, Companhia de Fiaçao e Tecidos Corcovado, Companhia de Fiaçao e Tecidos Industrial Mineira, Companhia de Fiaçao e Tecidos Mageénse, Companhia Manufactora Fluminense, Companhia Petropolitana, Companhia Progresso Industrial do Brasil, Companhia de Fiaçao e Tecidos Santo Aleixo, Companhia Fabrica de Tecidos Sao Pedro de Alcantara.

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 Sao Paulo* (Sao Paulo's major newspaper) and the *Diario Official do Estado de Sao 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. In fact, formal banks were so scarce as to be virtually non-existent. 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.[13]

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. In 1853, for example, it restricted the right to issue bank notes to a single enterprise, the Banco do Brasil, with the intention of creating a national financial system through the establishment of branches of this single bank. Four years later it reversed this course, authorizing the founding of six new banks of issue, but then reversed policy again in 1860 when it restricted the right of banks to issue currency and that imposed strict limitations on the formation of joint stock companies. Finally, in 1866 the government reserved for itself the right to issue currency, and restricted the Banco do Brasil, along with the few other commercial banks in operation, to rediscounting, mortgage loans, and deposit banking. The outcome of these continual policy changes was that Brazil neither developed a large number of independent banks, along the lines

[13] Topik, *Political Economy*, p. 28.

of the United States free banking model, nor created an extensive network of branch banks tied to the Banco do Brasil, along the lines of the French model. 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 they way they did in the United States or Western Europe.[14]

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.[15]

Given these constraints on the formation of financial intermediaries, the securities markets were not 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 publicly owned. The early 1870's witnessed the creation of two joint stock companies that raised their initial capital through public offerings in Rio de Janeiro: the Companhia Brasil Industrial (founded in 1871 by a group of well-known British merchants resident in Rio de Janeiro) and the Companhia Petropolitana (founded in 1874).[16] Even with these two joint stock companies, the capacity of the Brazilian cotton textile industry was only 85,000 spindles 1881 (see table 2).[17] Not only was this minuscule by the standards of the

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[14] Topik, *Political Economy*, p. 28. Peláez and Suzigan, *História monetária*, chaps. 2-5; Saes, *Crédito e bancos*, pp. 22, 73, 27-86; Levy, *História da bolsa*, pp. 109-112; Stein, *Brazilian Cotton Textile Manufacture*, pp. 25-27; Sylla, *American Capital Market*, pp. 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*, pp. 78-83, 96-97; Saes, *Crédito e bancos*, pp. 22, 86; Hanley, "Capital Markets "; Ridings, *Business Interest Groups*.

[16] Borja Castro, "Relatorio," 1866; Commissão 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.

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.[18]

This is not to argue that the only constraint faced by Brazilian industry was the scarcity of capital. There were other constraints as well, including the lack of protective tariffs and high internal transport costs because of the lack of a railroad system. It is to argue, however, that access to capital was one of a number of constraints.

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.[19] 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.

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

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[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," pp. 24, 27.

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 fundamentally 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. The net result, as Anne Hanley has so aptly put it, "was to make the interests of the economically wealthy states, Sao Paulo principal among them, the interests of the nation." As might be expected, the southern states used their newly-found political power to push through regulatory reforms that would maximize economic growth within their borders. Brazil's finance minister rapidly carried out banking reforms that went far beyond the 1888 reform and that freed the securities markets from the regulations that had dampened their activities for most of the century. In 1890 the government created three regional banks of issue whose currency was backed by treasury bonds. In addition, 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. More importantly, the government reformed the laws regulating joint-stock enterprises. The law of January 1890 not only maintained the provisions that firms only had to have 20 percent of their capital paid in to be publicly traded, and that made obtaining a corporate charter an administrative rather than a legislative procedure, it also drastically 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.[20]

This is not to argue that the First Republic completely deregulated the financial markets. In fact, the government instituted a set of mandatory disclosure laws that were highly

[20] Hanley, "Capital Markets," pp. 24-28; Topik, *Political Economy*, pp. 28-32; Peláez and Suzigan, *História monetaria*, pp. 141-143. Stein, *Brazilian Cotton Textile Manufacture*, p. 86.

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.[21]

The results of these reforms were dramatic. Brazil's money supply, which had grown at a rate of scarcely one percent per year since the 1870's, grew four-fold in the 12 months between December 1889 and December 1890. The nation's newly-formed banks, flush with investable funds and free to employ them without restriction, plunged into the Rio de Janeiro stock exchange, purchasing large numbers of corporate securities. The Rio exchange, which had been a staid and sleepy affair throughout the nineteenth century, now saw wild securities trading as well as an expansion of the number of firms listed. In the first year of the Encilhamento alone (as this speculative run-up of the market came to be called), the Rio exchange saw almost as much trading as it had in the previous sixty years combined.[22] Business enterprises mushroomed. The nominal capital of corporations listed on the Rio de Janeiro and Sao 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.[23]

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

[22] Topik, *Political Economy*, pp. 19-31.

[23] 1888 data from Neuhaus, *História monetária do Brasil*, p. 19ff. Data for 1889, 1890, and 1891 calculated from *O Estado de Sao 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.

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. Indeed, two of the most important textile manufacturers of the period were founded by major banks. The first, the Companhia Progresso Industrial do Brasil, was organized by the Banco Hipotecario in 1889, which then sold stock in the textile firm to the public. The second, the giant Fabrica Votorantim, was founded by the Banco Uniao de Sao Paulo in the early 1890's. Unlike the Companhia Progresso Industrial do Brasil, its stock was 100 percent held by the bank until the second decade of the twentieth century. At that point, the bank reconstituted itself as a publicly-owned textile company, dropping its less profitable banking operations and concentrating solely on the cotton cloth business.

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.[24] 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.

By international standards this was an extremely modest banking system. Moreover, Brazil's banks appear to have lent very little money for long-term investment. Most of their assets were held in cash and notes receivable (used to facilitate commercial transactions).[25] In

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[24] Neuhaus, *História monetária do Brasil*, p. 22.

[25] For a discussion of bank portfolios see Hanley, "Capital Markets;" Triner, "Banks."

fact, the analysis of the balance sheets of the 15 large-scale textile manufacturers from circa 1900-1905 indicates that only three had any itemized bank loans on their balance sheets at all. In two of the three, the value of the outstanding loans was less than five percent of total liabilities. Only one of the three, the Companhia de Tecidos de Sao Pedro de Alcantara, was significantly indebted to a bank. In 1900 this firm took out a mortgage on its properties worth 1,000 contos, which it increased to 3,000 contos in 1907, roughly equal to 17 percent of its total liabilities. These findings on the relative scarcity of long-term bank financing of the textile industry are consistent with the findings of Anne Hanley and Gail Triner on the loan portfolios of Brazil's major banks. Hanley and Triner have independently found that even though the law permitted banks to invest in industrial concerns, virtually none did so.[26]

The analysis of textile company balance sheets does indicate, however, that banks played an important role in providing short-term, working capital. As Table 3 shows, for the 15 firms whose balance sheets I have retrieved, during the period 1895-1915 short term debt made up roughly 30 percent of their total indebtedness. Of this 30 percent, roughly half was composed of "letras a pagar"-- essentially commercial paper. It is not known if the banks regularly rolled these debts over, turning short-term into long-term finance. We do know, however, that when these short-term liabilities grew large, textile firms tended to liquidate them by issuing long-term bonds which they used to pay off their short-term obligations. It is therefore probably safe to say that much of this commercial paper was likely rolled over with some regularity, but that this was viewed by textile industrialists as risky. The callable nature of these debts meant that banks could in fact demand full payment as soon as the notes came due. Issuing long term debentures that were callable by the textile firm was therefore strongly preferred.

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

[26] Hanley, "Capital Markets;" Triner, "Banks."

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 stockholders, 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.[27]

The overall process that took placed is reflected in table 2. In 1866 there were no publicly-owned joint stock companies in the cotton textile industry. By the early 1880's there were two, both of which were located in Rio de Janeiro. These two firms accounted 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

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

[27] von de Weid and Rodrigues Bastos, *Fio da meada.*

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.[28] 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 1890s were the only four publicly owned cotton textile producers listed on the exchange until the 1940s.[29] 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.[30] 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.

The widespread use of bonded debt was a major institutional innovation for Brazilian textile entrepreneurs. It allowed them to grow much more rapidly than would have been the case had they had to rely on the plowing back of retained earnings, but simultaneously meant

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[28] On the financing of the New England Textile Industry see McGouldrick, *New England Textiles*; Davis, "Sources."

[29] Haber, *Industry and Underdevelopment*, chapter 5.

[30] McGouldrick, *New England Textiles*.

that they did not have to further dilute their control of the equity of the firm by issuing more stock. The callable nature of the bonds also meant that firms could force debt holders to liquidate the debt at par at any time, giving entrepreneurs even greater flexibility. What this basically meant was that firms could increase their physical plant rapidly by issuing debt, and then quickly repay the loans out of profits. In fact, bonds rarely reached maturity: most were repurchased within 10 years of their being issued.

As early as 1895, four of Brazil's cotton textile firms sold debentures on the Rio exchange. This increased to 13 firms by 1905 (two of which were traded in both Sao Paulo and Rio), and to 34 firms by 1915 (22 in Rio, 11 in Sao Paulo, and one on both), when the use of the bond market peaked. Data from the industrial censuses of 1905, 1915, 1925, and 1934 indicates that there were other markets for debentures besides Rio de Janeiro and Sao Paulo. The 1905 census lists 19 such firms spread around the country, their combined bonded debt accounting for 45 percent of all bonded debt enumerated in the census. Over time these other exchanges became less important, yet even as late as 1934 there were 28 such firms listed in the census, their combined bonded debt accounting for 21 percent of all long term debt enumerated in the census.

For the well established, publicly owned textile enterprises of Rio de Janeiro 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 was already well developed, financed 69 percent of their growth in total capitalization through the sale of new debt (see table 4). Thus, the census data indicates that 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. Significantly, publicly-owned Sao Paulo firms did not use the bond market the way Rio de Janeiro firms did. Their average (weighted) debt-equity ratio was only .17:1.00 in 1915, and only 14 percent of their growth from 1905 to 1915 was financed through bonds. The explanation for this is fairly straight-forward. Almost all of the Sao Paulo firms had been founded since 1907, and as was the case in Rio de Janeiro, their initial

capitalization came from the sale of equities. Since their capital stock was of very recent vintage there was as yet little need to expand capacity by selling debt.

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 a 15 firm sample of publicly owned companies from their balance sheets. The balance sheet data indicates that if we factor in these other sources of debt, the debt-equity ratios increase dramatically. In fact, in 1915 the average (weighted) debt-equity ratio for these 15 firms was .58:1.00 (see table 3). 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).

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.[31] Even the growth in importance of the New York Stock Exchange at the turn of century did not dramatically alter this picture. An analysis I have conducted of the sources of industrial finance of publicly owned textile companies in the United States in 1910 indicates an average debt-equity ratio of .40:1.00, roughly the same as the debt-equity ratios for comparable Brazilian firms in that year. 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.[32] Even in 1920, when a few of the largest U.S. firms began to issue long term bonds,

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[31] On the early industrial U.S. see Davis, "Sources;" McGouldrick, *New England* Textiles.

[32] Debt equity ratios calculated from *Moody's* 1900, 1910, and 1920.

the debt-equity ratio was still only .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.[33]

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 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, less than one-third of their Brazilian counterparts. Moreover, the vast majority of this debt was contained in the industry leader, the Compañia Industrial de Orizaba. The other three publicly traded firms all had debt-equity ratios of .12:1.00 or less. None of this debt was long term.[34]

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; e.g., the Companhia de Tecidos Italo-Brasileira) numbered only four and accounted for only 2.8 percent of installed capacity. The balance sheet data from the 15 firm sample indicate much the same story. Of the 15 firms studied in detail, only one, the Companhia America Fabril, had any significant foreign liabilities. These were not contracted until the 1930's, however, and were made up entirely of

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[33] 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.

[34] Haber, *Industry and Underdevelopment*, chapter five.

long-term bonds sold in London. This debt accounted for just over 10 percent of America Fabril's total liabilities.

The absence of foreign investment in textiles is explained by three factors. The first is that 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. It was largely for this reason that most foreign investment in Brazil clustered in industries such as mining, in which revenues were earned in gold-backed currencies, or in railroads, which carried rate of return guarantees from the Brazilian government. It was also for this reason that on those few occasions that foreigners made long-term loans to Brazilian manufacturers, such as the aforementioned case of the Companhia America Fabril, they wrote the contract so as to require repayment in sterling, thereby shifting all of the exchange risk to the borrowing firm. Under such conditions of uncertainty, it is easy to understand why few Brazilian firms were willing to bear this risk.

The second reason why foreigners so rarely invested in Brazilian manufacturing was that as a general rule they tended to invest only where they had some distinct advantage over local entrepreneurs. This was not only true of foreign direct investment in Brazil, but was true of foreign direct investment elsewhere in the world. Even the Indian cotton textile industry was locally financed: British overseas investors played virtually no role at all. 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. In these cases, foreign investors could earn rents from their privileged access to scarce factors of production. 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: income was earned in depreciating currency; the scale of production was modest enough that it could be financed by local financial markets; and the technology to produce cotton cloth was freely available.

The third reason for the relative absence of foreign investment is an interesting political economy problem. 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.[35] Overseas investors would have been relatively poorly placed politically to press the case for protection, since they were not part of the government's constituency. 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 2 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 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

[35] For a history of the struggle by industrialists to obtain protective tariffs see Vilela Luz, *Luta.*

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.[36]

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.[37] 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 65 firms that appear in both the 1905 and 1915 censuses, segmenting them into three categories: publicly-held firms, privately-owned firms, and firms that switched from being private to being public. Panel II of the same table repeats the operation, this time looking at 113 firms that appear in both the 1915 and 1925 censuses. The results of both panels are unambiguous. First, publicly-owned firms were close to three times larger, as measured by spindlage, than their privately-owned competitors.

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[36] Leff, "Economic Development," p. 58. Suzigan, *Industria Brasileira*.

[37] 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."

Second, the rate of growth of new investment (as measured by spindlage) in public firms was consistently faster than in privately owned firms. In fact, from 1915 to 1925 the difference in growth rates was nearly five to one. Third, the rate of growth of new capacity was fastest of all in firms that switched from being privately-owned to being publicly-held. In 1905-1915 their rate of growth was roughly four times that private firms, and in 1915-1925 their rate was nearly nine times the rate of private firms. The implication is that 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.

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. In 1905 the industry would have been 26 percent smaller, in 1915 39 percent smaller, and in 1927 46 percent smaller.

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 the publicly traded firms they replaced, otherwise they would have come into existence anyway and out competed the publicly held 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 at the same time that Brazil did. Mexico is a such a case. Like Brazil, Mexico encouraged domestic industry by instituting high tariffs (circa 1910 they had the highest tariffs in the world on cotton cloth), and like Brazil, Mexico rapidly built an integrated rail grid during the period 1890-1914 that unified the market and made large scale industry possible for the first time.[38] 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.[39]

The second impact of the opening up of the securities markets was a decrease in the level of industrial concentration. As the Brazilian cotton textile industry grew in size concentration, as measured both by four-firm ratios and Herfindahl indices, declined (see table 7). Since there was a large group of entrepreneurs who could utilize the securities markets to provide long-term finance, differential access to capital did not serve as a barrier to entry. With constant returns to scale technology, this meant that as the industry grew in size concentration declined proportionately. It is important to keep in mind, however, that this is not the result that occurred in Mexico. There, the growth of the textile industry was accompanied by a rise in concentration because differential access to capital from the securities markets gave a small number of firms tremendous advantages over their competitors. In fact,

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[38] Graham Clark, *Cotton Goods*, p. 38.

[39] Stephen Haber, "Financial Markets," pp.

as table 7 demonstrates, from 1878 to 1902 concentration in Mexican industry increased at least two-fold as measured by the four firm ratio and three-fold as measured by the Herfindahl index at the same time that the Mexican industry more than doubled in size.[40]

The third impact of the development of the financial markets in Brazil was an increase in productivity: publicly-held firms were significantly 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.

Table 8 presents estimates of mean (weighted by firm size) factor productivity by firm type and size covering the years 1866 to 1927. TFP is estimating by combining the capital and labor inputs using weights of .32 and .68, respectively, which were obtained from the first specification of the production functions presented in table 9 by normalizing the capital and labor coefficients to one. Spindles are employed as a proxy for capital, the number of workers is employed as the proxy for labor.[41] The estimates presented here break firms into two categories, publicly held 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

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[40] On the high level of industrial concentration in Mexico, see Haber, "Financial Markets".

[41] Ideally one would want to know the replacement cost of capital, the number of man-hours of labor, and the per hour labor cost in each firm. For historical work, such data is unavailable. Economic historians of the United States, for example, have generally employed the number of workers as a proxy for the labor input and the nominal value of capital as the capital input. See, for example, Sokoloff, "Was the Transition" and Atack "Estimation of Economies of Scale." I follow their method in regard to labor, but employ the number of spindles per firm as the proxy for capital. I employ spindlage because it produces roughly similar capital coefficients in the production function as does the nominal value of capital, but at a much higher level of statistical significance. The reason has to do with significant differences in how firms defined capital. Joint stock companies uniformly reported capital as the par value of debt and equity, plus the book value of reserves. For privately owned firms, however, value assessments were less straight-forward. Some firms appear to have reported the value of machinery and buildings at acquisition cost, some the nominal value of the partnership that owned the firm, some an estimate of the current value of the enterprise. These differences in assessments are made even more complicated by vintage effects. Ceteris paribus, older firms, privately owned as well as publicly traded, will tend to have lower reported values of capital than newer firms. Employing counts of machinery gets around these problems.

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 large, public 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. Also note that output is measured as the nominal value of production, because the extent price indices are seriously flawed. While it is reasonable to use these indices to estimate long-run trends in the movement of prices, their volatility makes them useless if one wishes to deflate output in any year or set of years. My purpose in this table is to make comparisons across firm types and sizes in individual years, not to make comparisons across firm types over time.

A number of features of the data are immediately obvious. The first is that average output per worker is anywhere from 15 to 45 percent higher (depending on the year) in publicly-owned 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 the capital-labor ratio. On average, publicly held firms had anywhere from 12 to 37 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 public firms appear to have been the most capital intense. Note that reporting the weighted means for each category, rather than the median or an unweighted mean, understates the differences between firm types and size categories.

Given the differences in output per worker across size categories and firm types, it should not be surprising that the weighted mean of TFP for all publicly held firms was

anywhere from 1 to 24 percent higher than for all privately held firms. What is perhaps surprising is the huge TFP gap--roughly 30 percent-- between small public firms and large public firms. This suggests that the reason for the higher TFP in public firms was not scale economies in production. Note again that the weighted averages reported here understate the differences between firms types and sizes. Calculations based on median or unweighted averages of TFP reveal even larger gaps.

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. I employ panel data techniques to estimate Cobb Douglas Production Functions where capital is measured in spindles, labor as the number of workers, and output as the value of production. These output values are not deflated, because of the lack of an adequate price index, but because we are interested only in the difference between traded and private firms, not the absolute level of TFP in any given year, this is not a problem.[42] The regression technique is OLS. The results are reported in table 9.

Specification two of the regression, which adds a time dummy to the other variables, indicates that the rate of growth of nominal TFP on average was 4.4 percent per year. Considering that the available (highly imperfect) price indices indicate an average trend rate of growth of inflation from 1866 to 1927 of 1.8 percent, this implies a real rate of productivity growth of 2.6 percent.

What then was the TFP difference between publicly-held and privately-owned firms? Specification 4 adds a dummy for joint stock and an interaction of the joint stock dummy on time. The results indicate that on average limited liability joint stock companies had TFP growth 2.4 percent per year faster than the average for the industry. The joint stock intercept dummy is negative, but only because the slope of the interaction of joint stock on time is so

[42] The regression assumes that whatever the rate of inflation affecting the price of cloth it is uniform across all cloth types and is captured, by the time trend variable. What is therefore relevant is the size and sign of the interaction of time on the dummy variables for traded, bond, and region, which indicate the degree to which a particular group of firms departed from the general trend.

steep. In specification 3 of the regression, which does not include a time variable or interactions of dummy variables on time, the joint stock dummy is positive and statistically significant. Note that controlling for vintage effects (firm age) has little impact on these results (see specification 6).

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. Specification five tests this hypothesis and finds no statistical relationship between being traded and having higher productivity growth. This is a curious result. It may well 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, which held on to them precisely because the investment was so profitable.

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.[43] Specification 8 tests these hypotheses by introducing a dummy variable for firms whose bonds were traded on either the Rio de Janeiro or Sao Paulo markets, as well as an interaction of time and the bond dummy. The results indicate that the first hypothesis clearly does not hold. Limited liability joint stock firms which issued bonded debt actually had lower rates of growth of TFP than publicly owned firms that did not issue

[43] Brander and Spencer, "Moral Hazard," pp. 833-849.

bonded debt. In fact, joint stock firms that did not have long term bonded debt had rates of growth of TFP twice that of the industry average.

One might argue that these differences in TFP between publicly-held 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, and that controlling for this would eliminate differences in TFP growth between public and private firms. Specifications 9, 10, and 11 therefore introduce a dummy variable for those firms that were located in the highly integrated, rapidly growing, four-state market of Rio de Janeiro, the Distrito Federal, Minas Gerais, and Sao Paulo, as well as an interaction of the regional dummy variable on time. All three specifications yield the same qualitative result. Firms in this region did in fact have higher rates of growth of productivity than the average. Even if we control for region, however, there is still a large and statistically significant residual associated with being a joint stock limited liability company: On average, joint stock limited liability companies had rates of growth of productivity 1.9 percent per year faster than the average for the industry (see specification 10).

What were the sources of these observed differences in productivity growth? Table 10 presents a set of Cobb-Douglas Production Functions that are designed to decompose productivity differentials between joint stock and private firms. The specification of the production function is slightly altered by normalizing output and capital by labor in order to see the relationship between firm type and the capital-labor ratio. Specifications 1 and 2 indicate that there was a significant difference in the capital-labor ratio between limited liability, joint stock firms and their private competitors. Note how the introduction of a dummy variable for joint stock, and an interaction of that dummy variable on time, in specification 2 lowers the coefficient on the capital-labor ratio in specification 1, indicating that joint stock firms had a higher capital-labor ratio than the average for the industry. Note also that when we control for firm type the scale coefficient (represented here by the natural log of workers) becomes negative. The implication is that output per worker is negatively correlated with firm size

when we control for firm type. This finding is consistent with the mean TFP estimates by firm type presented in table 8, which indicated that the most productive firms were small, joint stock, limited liability companies.

Perhaps it was the case that the differences in TFP were the product of differences in firms sizes. Specifications 3 and 4 therefore analyze only small firms (defined as those with 13,500 spindles or less). The regressions indicate that the elasticity of output per worker with respect to the capital-labor ratio was lower in small firms than in the industry as a whole. It was still the case, however, that small-sized, joint stock, limited liability firms had a higher capital-labor ratio than the average small firm. Perhaps even more striking, the difference in the rate of growth of TFP between small public firms and small private firms is even larger than that observed to have existed between public and private firms of all sizes. Note that in specification 2 (which includes all firms) public firms had a rate of growth of TFP 2.4 percent faster than the industry average, while in specification 4 (which includes only small firms) the rate of growth of TFP was 3.2 percent higher than the industry average.

What advantage was conferred on publicly held firms because of their higher capital-labor ratio? What was the relationship between a higher ratio of spindles per worker and increased levels of output per worker? Two censuses (1907 and 1915) provide detailed information on output types by firm. These indicate that public firms tended to produce more fine-weave, high quality goods than private firms. In addition, the 1866, 1915, 1923, 1924, 1925, 1926, and 1927 censuses provide information on both the value and volume of output, allowing me to calculate the average price of cloth produced by different firm types. The price data is consistent with the inforation in the 1907 and 1915 censuses about output types: public firms produced higher price cloth than private firms, indicating that they were specializing in the production of fine-weave, high quality cloth. 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. Specifications 5, 6, 7, 8 test this hypothesis by restricting the sample to those firms that reported the volume of meters produced and by introducing (in specifications 7 and 8) as an independent variable the volume of output (in meters). A high volume of output relative to the value of output per worker is taken here as a proxy for low quality cloth. The results indicate that if we control for the volume of output, the statistical relationship between being a public firm and having higher TFP growth actually increases (note the increase in the interaction of time and joint stock from .015 to .021 from specification 6 to specification 7). Note also that both the coefficient on the capital-labor ratio and the scale coefficient drop from specification 6 to specification 7. This indicates that firms that produced high quality cloth tended to be smaller than the average firm and that they had a higher capital-labor ratio than the average. Finally, if we compare the results in specifications 7 and 8 we note that removing the joint stock variables from the regression (specification 8), produces no appreciable change in the coefficient on the volume of output. The coefficient on the capital-labor ratio does, however increase dramatically. In short, producing high quality output is correlated with having a high capital-labor ratio, and both are correlated with being a limited liability joint stock company. This suggests that the mechanism at work was the following. Limited liability joint stock companies had lower capital costs. They therefore could afford higher capital-labor ratios, which meant in turn that they could specialize in high value output.

A skeptical reader might perhaps argue that the TFP estimates by firm type presented in table 8 indicate that this relationship exists only for larger firms, and that at small firm sizes some other mechanism was at work. Specifications 9, 10, 11, 12 of table 10 therefore reproduce the regressions from specifications 5-8, but restrict the sample to small firms. The results indicate that if anything, the correlation between a high capital labor ratio, specialization in high quality output, and being a limited liability joint stock company are even stronger at small firm sizes.

An even more 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 public and private firms meant that public 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. There is a relatively straightforward way to test this hypothesis: Stigler's survivor method. 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 11 demonstrates that the fastest growing type of firm was limited liability joint stock companies, and among these firms the fastest growing size categories were firms with capacity shares of less than 0.5 percent. From 1905 to 1915 the number of public companies grew three-fold, while privately-owned firms grew by just 60 percent. From 1915 to 1925 all of the net new firms in the industry were public companies. From 1925 to 1934 the rate of growth of the two categories was identical. This is not surprising in light of the fact that the Great Depression likely dampened the investing public's demand for corporate securities. 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. Moreover, the fastest growing category of firms were small public companies. From 1905 to 1934 the number of publicly owned companies with capacity shares of less than 0.5 percent increased nearly six-fold. The size category with the next fastest rate of growth were small (less than 0.5 percent capacity shares) private firms, which tripled in number. In short, the survivor results mirror both the TFP estimates presented in table 8 and the results of the multivariate regressions presented in tables 9 and 10. Technical efficiency and economic efficiency were one and the same in the case under study.

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. Banks played an important role by discounting commercial paper, but they provided little direct long-term finance. 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 to monitor other shareholders, and thereby allowed entrepreneurs to mobilize capital from the securities markets.

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, a fall in the level of concentration, and an increase in the rate of growth of productivity.

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Table 1
Financial Stock of the Rio de Janeiro and São Paulo Securities Exchanges, 1880-1919

Equities (in Thousands of Current Milreis at Par Value) at Year End

Year	Banks	Railroads	Navigation & Transport	Insurance	Public Services	Agriculture	Diverse Industries	Textiles	Total
1880	84,000	60,005	9,930	27,800	1,000	0	40,100	0	222,835
1889	583,251	195,951	20,018	52,900	0	14,150	76,395	21,100	963,765
1890	893,000	384,451	63,444	53,500	0	105,060	516,955	45,100	2,061,510
1891	1,451,050	979,370	41,073	57,600	0	146,200	1,019,192	84,210	3,778,695
1900	150,678	399,900	42,073	40,400	0	3,551	400,223	64,740	1,101,565
1910	262,910	616,718	31,923	21,750	18,735	18,103	429,014	120,490	1,519,643
1919	1,317,081	874,891	70,206	31,186	63,984	41,680	775,149	202,432	3,376,609

Equities (As Percent of Total Equities)

Year	Banks	Railroads	Navigation & Transport	Insurance	Public Services	Agriculture	Diverse Industries	Textiles	Total
1880	38%	27%	4%	12%	0%	0%	18%	0%	100%
1889	61%	20%	2%	5%	0%	1%	8%	2%	100%
1890	43%	19%	3%	3%	0%	5%	25%	2%	100%
1891	38%	26%	1%	2%	0%	4%	27%	2%	100%
1900	14%	36%	4%	4%	0%	0%	36%	6%	100%
1910	17%	41%	2%	1%	1%	1%	28%	8%	100%
1919	39%	26%	2%	1%	2%	1%	23%	6%	100%

Bonds (In Thousands of Current Milreis at Par Value)

Year	Public Debt	Mortgage Paper	Corporate Debt	Total
1880	533,437	0	0	533,437
1889	593,593	49,611	90,038	733,242
1890	593,716	78,456	35,338	707,510
1891	593,716	241,590	52,455	887,761
1900	711,102	37,597	770,313	1,519,011
1910	2,255,616	8,260	1,711,341	3,975,216
1919	3,073,407	14,148	1,470,016	4,557,570

Source: Estimated from Jornal do Commercio, composite stock page, January 1881, 1890, 1891, 1892, 1901, 1901, 1911, 1920; and O Estado de São Paulo, composite stock page, January 1911, 1920.

Table 2
Brazilian Cotton Textile Industry, 1866-1934
Limited Liability Joint Stock Firms as a Percent of All Firms

Year	Total Firms	Total Spindles	Joint Stock Firms in Rio de Janeiro(a) #	% of total	Joint Stock Firms in São Paulo #	% of total	Total number (b) of Joint Stock firms #	% of total	Spindles Joint Stock RJ	% of Total	Spindles Joint Stock SP	% of Total	Spindles Total (b) Joint Stock	% of Total
1866	9	14,875												
1875	11	45,830	1	9%			1	9%	20,000	44%			20,000	44%
1881	24	84,956	2	8%			2	8%	29,660	35%			29,660	35%
1883	24	78,908	2	8%			2	8%	25,500	32%			25,500	32%
1885 *		66,466 *												
1895 *	22	260,842	9	--	2	--	13	--	164,405	--	8,204	--	192,275	--
1898 *	18	279,666 *	14	--			14	--	255,578	--			255,578	--
1905	90	778,224	17	19%	3	3%	25	28%	316,310	41%	27,606	4%	358,740	46%
1907	117	823,343	19	16%	5	4%	30	26%	321,783	39%	65,329	8%	402,863	49%
1908 *	119	761,816 *	10	8%	6	5%	16	13%	267,011		62,857		329,867	--
1914	205	1,634,449	25	12%	29	14%	66	32%	512,387	31%	384,206	24%	983,404	60%
1915	170	1,598,568	25	15%	25	15%	63	37%	517,757	32%	358,096	22%	972,935	61%
1921 *	242	1,621,300 *												
1923 *	243	1,700,000 *												
1924	184	2,200,612	23	13%	27	15%	69	38%	821,682	37%	521,934	24%	1,475,982	67%
1925	183	2,397,380	25	14%	34	19%	80	44%	870,226	36%	668,710	28%	1,689,357	70%
1926	215	2,558,433	23	11%	44	20%	92	43%	890,902	35%	700,261	27%	1,751,761	68%
1927	228	2,692,077	25	11%	41	18%	94	41%	880,561	33%	719,871	27%	1,788,244	66%
1934	203	2,507,126	26	13%	32	16%	83	41%	796,696	32%	624,314	25%	1,618,310	65%

* Estimate based upon partial information.
** Includes only RJ and DF firms.

(a) Includes Distrito Federal firms.
(b) This is a national count of limited liability joint stock companies, including RJ and SP firms.

Sources:

1866 Borja Castro, "Relatorio," pp. 3-73.
1875 Commissão (para) Exposição Universal (em) Philadelphia, Empire of Brazil, pp. 285-287 and statistical tables.
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1883 Branner, "Cotton Factories of Brazil - 1883." In Branner, Cotton in the Empire of Brazil.
1885* Consul Ricketts, Report, C4657, 1xv(1886), pp. 187-188 as cited by Stein, Brazilian Cotton, Appendix I.
1895* dos Santos Pires, Relatorio, pp. 24-25.
1898** de Carvalho, "Cafe." Also, de Carvalho, "Algodão."
1905 Cunha Vasco, "Industria de Algodao".
1907 Censo Industrial do Brasil, "Industria de Transportes."
Prefeitura do Distrito Federal, Noticia.
1908 Graham Clark, Cotton Goods.
Cunha Vasco, Fabrica de Fiação.
Bandeira Junior, Industria no Estado de São Paulo, pp. 3-169.
1914 Centro Industrial do Brasil, Relatorio da Directoria, 1915.

1915 Centro Industrial do Brasil, Centro na Conferencia Algodeira.
1921* Centro Industrial de Fiação e Tecelagem de Algodão (hereafter referred to as CIFTA), Relatorio da Directoria, 1921-1922.
1923* CIFTA, Exposição de Tecidos.
CIFTA, Relatorio da Directoria 1923.
1924 CIFTA, Relatorio da Directoria, 1924.
1925 CIFTA, Relatorio da Directoria, 1925.
1926 CIFTA, Fabricas Filiadas.
1927 CIFTA, Relatorio da Directoria, 1928.
1934 CIFTA, Fiação e Tecelagem.

Table 3
Debt Equity Ratios and Sources of new Capital for 15 Firm Sample, 1895-1940

Panel I: Composite Debt Equity Ratios
(Estimated From Balance Sheets, Weighted by Total Liabilities, Includes Short-Term Debt)

Year	Paid Capital	Retained Earnings	Short Term Debt	Bond Debt	Total Liabilities
1895	$10,000,000	$1,214,649	$2,230,474	$5,374,400	$18,819,523
1900	$53,221,864	$15,797,958	$8,530,865	$18,582,652	$96,133,339
1905	$60,966,962	$30,148,958	$7,381,621	$16,164,758	$114,662,299
1910	$75,901,065	$28,401,947	$18,911,386	$26,173,501	$149,387,899
1915	$80,974,681	$29,898,382	$26,175,814	$37,566,651	$174,615,528
1920	$114,874,586	$43,393,476	$20,640,288	$44,827,972	$223,736,322
1925	$145,238,808	$118,214,617	$54,044,464	$39,225,946	$356,723,835
1930	$136,622,981	$100,022,326	$64,682,923	$78,469,149	$379,797,379
1935	$134,766,465	$124,200,554	$65,983,405	$64,481,562	$389,431,986
1940	$145,058,630	$143,492,568	$73,881,985	$46,118,724	$408,551,907

Year	Debt Equity Ratio	Short Term/ Debt	Bond Debt/ Debt+ Equity	Retained Earnings/ Debt+ Equity	Paid Capital/ Debt+ Equity
1895	0.678	0.293	0.286	0.065	0.531
1900	0.393	0.315	0.193	0.164	0.554
1905	0.258	0.313	0.141	0.263	0.532
1910	0.432	0.419	0.175	0.190	0.508
1915	0.575	0.411	0.215	0.171	0.464
1920	0.414	0.315	0.200	0.194	0.513
1925	0.354	0.579	0.110	0.331	0.407
1930	0.605	0.452	0.207	0.263	0.360
1935	0.504	0.506	0.166	0.319	0.346
1940	0.416	0.616	0.113	0.351	0.355

Panel II: Sources of New Capital
(Estimates Weighted by Size of Total Liabilities, Includes Short Term Debt)

Years	Growth of Short-term Debt as % of Growth Debt+Equity	Growth of Bond Debt as % Growth Debt+Equity	Growth of Retained Earnings as % as % Growth Debt+Equity	Growth Paid Capital as % Growth Debt+Equity
1895-00	8.1%	17.1%	18.9%	55.9%
1900-05	-6.2%	-13.0%	77.5%	41.8%
1905-10	33.2%	28.8%	-5.0%	43.0%
1910-15	28.8%	45.2%	5.9%	20.1%
1915-20	-11.3%	14.8%	27.5%	69.0%
1920-25	25.1%	-4.2%	56.3%	22.8%
1925-30	46.1%	170.1%	-78.8%	-37.3%
1930-35	13.5%	-145.2%	251.0%	-19.3%
1935-40	41.3%	-96.0%	100.9%	53.8%

Source: See note 11 in the text.

Table 4
Financial Structure of Brazilian Cotton Textile Firms, 1905-1934
(Does Not Include Short Term Debt, in current milreis)

Year		Firms	Paid Capital	Long Term Debt	Reserves	Capital Plus Reserves	Total Capital	Debt Equity Ratio	New Paid Capital as % of Change Total Capital*	New Long Term Debt as % of Change Total Capital*	New Reserves % of Change Total Capital*
1905	All Brazil	90	---	28,268,175	---	177,139,952	205,408,127	0.160			
	Firms located in RJ or DF	19	---	13,404,180	---	93,045,300	106,449,480	0.144			
	Firms located in SP	17	---	3,900,000	---	23,678,290	27,578,290	0.165			
	Joint Stock Firms in RJ	17	---	13,404,180	---	77,245,300	90,649,480	0.174			
	Joint Stock Firms in SP	3	---	3,900,000	---	5,713,290	9,613,290	0.683			
	Joint Stock Firms in other States	4	---	461,200	---	7,473,275	7,934,475	0.062			
	Total Joint Stock Firms	24	---	17,765,380	---	90,431,865	108,197,245	0.196			
	Total Private Firms	66	---	10,502,795	---	86,708,087	97,210,882	0.121			
	Joint Stock Firms as % Brazil		---	62.8%	---	51.1%	52.7%				
									(Change from 1905 to 1915)		
1915	All Brazil	174	263,994,000	81,033,600	40,959,896	304,953,896	385,987,496	0.266	---	29.2%	---
	Firms located in RJ or DF	30	86,610,000	46,064,000	21,194,944	107,804,944	153,868,944	0.427	---	68.9%	---
	Firms located in SP	43	79,499,000	14,682,600	8,337,762	87,836,762	102,519,362	0.167	---	14.4%	---
	Joint Stock Firms in RJ	25	79,100,000	40,064,000	21,194,944	100,294,944	140,358,944	0.399	---	53.6%	---
	Joint Stock Firms in SP	25	66,750,000	14,682,600	8,327,445	75,077,445	89,760,045	0.196	---	13.5%	---
	Joint Stock Firms in other States	12	16,888,000	5,593,000	1,949,049	18,837,049	24,430,049	0.297	---	31.1%	---
	Total Joint Stock Firms	62	162,738,000	60,339,600	31,471,438	194,209,438	254,549,038	0.311	---	29.1%	---
	Total Private Firms	112	101,256,000	20,694,000	9,488,458	110,744,458	131,438,458	0.187	---	29.8%	---
	Joint Stock Firms as % Brazil		61.6%	74.5%	76.8%	63.7%	65.9%				
									(Change from 1915 to 1925)		
1925	All Brazil	189	462,574,631	103,432,037	350,230,953	812,805,583	916,237,620	0.127	37.5%	4.2%	58.3%
	Firms located in RJ or DF	28	152,310,000	52,421,674	131,327,509	283,637,509	336,059,183	0.185	36.1%	3.5%	60.4%
	Firms located in SP	53	177,762,000	31,916,763	143,413,297	321,175,297	353,092,060	0.099	39.2%	6.9%	53.9%
	Joint Stock Firms in RJ	25	147,700,000	52,421,674	131,182,509	278,882,509	331,304,183	0.188	35.9%	6.5%	57.6%
	Joint Stock Firms in SP	33	158,520,000	31,612,763	141,622,297	300,142,297	331,755,060	0.105	37.9%	7.0%	55.1%
	Joint Stock Firms in other States	20	25,963,000	5,879,400	19,324,172	45,287,172	51,166,572	0.130	33.9%	1.1%	65.0%
	Total Joint Stock Firms	78	332,183,000	89,913,837	292,128,978	624,311,977	714,225,814	0.144	36.9%	6.4%	56.7%
	Total Private Firms	111	130,391,631	13,518,200	58,101,975	188,493,606	202,011,806	0.072	41.3%	-10.2%	68.9%
	Joint Stock Firms as % Brazil		71.8%	86.9%	83.4%	76.8%	78.0%				
									(Change from 1925 to 1934)		
1934	All Brazil	244	604,610,274	217,941,812	270,537,455	875,147,729	1,093,089,541	0.249	80.3%	64.7%	-45.1%
	Firms located in RJ or DF	35	167,504,500	72,624,678	118,485,279	285,989,779	358,614,457	0.254	67.4%	89.6%	-56.9%
	Firms located in SP	98	235,012,364	98,443,371	64,692,637	299,705,001	398,148,372	0.328	127.1%	147.7%	-174.7%
	Joint Stock Firms in RJ	25	149,204,500	72,624,678	117,756,985	266,961,485	339,586,163	0.272	18.2%	243.9%	-162.1%
	Joint Stock Firms in SP	31	175,910,600	98,218,371	60,632,703	236,543,303	334,761,674	0.415	578.4%	2215.3%	-2693.7%
	Joint Stock Firms in other States	25	60,300,000	19,682,200	23,288,808	83,588,808	103,271,008	0.235	65.9%	26.5%	7.6%
	Total Joint Stock Firms	81	385,415,100	190,525,249	201,678,497	587,093,597	777,618,846	0.325	84.0%	158.7%	-142.7%
	Total Private Firms	163	219,195,174	27,416,563	68,858,958	288,054,132	315,470,695	0.095	78.3%	12.2%	9.5%
	Joint Stock Firms as % Brazil		63.7%	87.4%	74.5%	67.1%	71.1%				

* These last three categories measure the respective shares of paid capital, long term debt, and reserves on increases to total capital. For example, between 1905 and 1915, new long term debt (52,765,425 milreis) accounted for 29.2% of the increase of total capital (180,579,369 milreis) for all firms.

Sources:
Estimated from: Borja Castro, "Relatorio," pp. 3-73; Commissão de Inquerito Industrial, Relatorio;Branner, Cotton in the Empire of Brazil, Ministerio da Industria Viação e Obras Publicas, Relatorio; Vasco, "Industria de Algodão;" Centro Industrial do Brasil, O Brasil; Centro Industrial do Brasil, Relatorio 1915; Centro Industrial do Brasil, O Centro Industrial;Centro Industrial de Fiação e Tecelagem, Relatorio, 1924, 1925, 1926; Centro Industrial de Fiação e Tecelagem de Algodão, Estatisticas da Industria; Centro Industrial de Fiação e Tecelagem, Fiação e Tecelagem; Stein, Brazilian Cotton, Appendix 1.

Table 5
Growth in Installed Capacity, Same-Firm Comparisons, 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
Joint Stock	19	336,814	534,404	17,727	28,127	59%
Private	38	276,134	381,890	7,267	10,050	38%
Switched-- Private to Joint Stock during 1905-15	8	72,538	182,928	9,067	22,866	152%

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
Joint Stock	46	837,360	1,256,668	18,203	27,319	50%
Private	65	488,100	542,309	7,509	8,343	11%
Switched-- Private to Joint Stock during 1915-25	2	9,000	17,600	4,500	8,800	96%

Source: Same as Table 2.

Table 6
Counterfactual analysis of Textile Industry Capacity, 1866-1934

Year	Number of Firms			Average Number of Spindles in Private Firms	Industry Capacity		Size Loss to Industry Percent
	Total	Private	Joint Stock		Estimated	Actual	
1866	9	9	0	1,653	14,875	14,875	0%
1875	11	10	1	2,583	28,413	45,830	38%
1882	24	22	2	2,513	60,323	84,956	29%
1883	24	22	2	2,428	58,264	78,908	26%
1905	90	66	24	6,356	572,024	778,224	26%
1907	117	87	30	4,833	565,474	823,343	31%
1914	204	140	64	4,616	941,739	1,629,695	42%
1915	170	109	61	5,740	975,757	1,598,568	39%
1924	184	117	67	6,193	1,139,590	2,200,612	48%
1925	183	109	74	6,496	1,188,699	2,397,380	50%
1926	214	132	82	6,060	1,296,826	2,551,673	49%
1927	228	143	85	6,321	1,441,076	2,692,077	46%
1934	203	123	80	7,226	1,466,908	2,507,126	41%

Source: Same as Table 2.

Table 7
Indices of Concentration in the Cotton Textile Industries
of Brazil and Mexico, 1843-1934

	MEXICO		BRAZIL	
Year	Four Firm Ratio	Herfindahl Index	Four Firm Ratio	Herfindahl Index
1843	0.376	0.0524		
1850	0.449	0.0686		
1853	0.430	0.0677		
1862	0.319	0.0490		
1865	0.342	0.0501		
1866			0.766	0.1773
1878	0.160	0.0209		
1881			0.376	0.0631
1883	0.189	0.0225	0.371	0.0582
1888	0.217	0.0249		
1891	0.228	0.0268		
1893	0.284	0.0355		
1895	0.363	0.0480	0.349	0.0585
1896	0.371	0.0513		
1902	0.381	0.0637		
1905			0.207	0.0279
1906	0.338	0.0486		
1907			0.203	0.0250
1912	0.271	0.0343		
1915			0.161	0.0165
1919	0.374	0.0592		
1924			0.212	0.0222
1925			0.179	0.0182
1926			0.166	0.0155
1927			0.162	0.0141
1929	0.278	0.0335		
1934			0.173	0.0168

Concentration by estimated value of sales, measured at the firm level. A detailed discussion of the estimation procedures is available from the author.

Source: Haber, "Financial Markets", 1997.

Table 8
Average Total Factor Productivity by Firm type and Size, Brazilian Cotton Textile Industry, 1866-1927
TFP Estimated using normalized Capital and Labor Weights from Production Functions Reported in Table 9
(Weighted by Firm Size)

		Reporting Firms			Average Output Per Worker			Average Output Per Spindle			Average Spindles Per Worker			Average Total Factor Productivity		
Year	Firm Sizes	Public	Private	Total	Public	Private	Diff.	Public	Private	Diff	Public	Private	Diff	Public	Private	Diff.
1866	Total	0	9	9		2,514			133			21			401	
	< 13,500	0	9	9		2,514			133			21			401	
1882	Total	2	15	17							44	19	129%			
	<13,500	1	15	16							28	19	43%			
	>13,500	1	0	1							60					
1883	Total	2	15	17							39	20	96%			
	<13,500	1	15	16							28	20	39%			
	>13,500	1	0	1							50					
1905	Total	20	59	79							21	18	14%			
	<13,500	11	54	65							15	17	-10%			
	>13,500	8	5	13							28	30	-6%			
	America Fabril	1		1							21					
1907	Total	20	50	70	3,426	2,464	39%	192	184	5%	21	17	23%	431	421	3%
	< 13,500	10	48	58	2,887	2,491	16%	236	188	26%	14	17	-18%	613	462	33%
	>13,500	9	2	11	4,025	1,821	121%	144	93	56%	30	30	-1%	394	209	89%
	America Fabril	1		1	3,030			145			21			410		
1914	Total	47	76	123	3,678	3,103	19%	166	169	-2%	26	21	22%	414	409	1%
	< 13,500	27	69	96	3,171	3,113	2%	182	173	5%	21	21	0%	422	440	-4%
	>13,500	19	7	26	4,399	3,014	46%	144	133	8%	33	25	36%	412	351	17%
	America Fabril	1		1	3,896			141			28			408		
1915	Total	50	89	139	3,770	2,978	27%	202	182	11%	22	19	17%	479	454	5%
	< 13,500	29	81	110	3,657	2,918	25%	235	180	30%	19	19	1%	600	452	33%
	>13,500	20	8	28	3,934	3,584	10%	155	200	-22%	27	23	17%	437	459	-5%
	America Fabril	1		1	3,871			141			28			408		
1924	Total	64	97	161	9,743	6,712	45%	415	420	-1%	23	17	37%	1,103	985	12%
	< 13,500	40	84	124	9,533	6,920	38%	464	447	4%	18	16	11%	1,356	1,171	16%
	>13,500	23	13	36	10,108	5,365	88%	328	246	34%	32	21	56%	1,016	735	38%
	America Fabril	1		1	8,857			216			41			642		
1925	Total	69	86	155	10,558	7,333	44%	557	465	20%	22	18	21%	1,367	1,098	24%
	< 13,500	45	76	121	10,603	7,438	43%	624	484	29%	19	18	8%	1,708	1,333	28%
	>13,500	23	10	33	10,471	6,536	60%	426	318	34%	27	22	26%	1,239	875	42%
	America Fabril	1		1	7,848			216			36			638		
1926	Total	74	95	169	8,953	7,429	21%	470	542	-13%	21	18	17%	1,225	1,178	4%
	< 13,500	45	82	127	9,422	7,491	26%	515	570	-10%	20	18	15%	1,435	1,281	12%
	>13,500	28	13	41	8,200	7,038	17%	398	365	9%	23	21	8%	1,146	1,043	10%
	America Fabril	1		1	7,286			178			41			528		
1927	Total	78	105	183	8,264	7,204	15%	432	542	-20%	22	20	12%	1,089	1,053	3%
	< 13,500	47	91	138	8,240	7,385	12%	476	571	-17%	20	19	6%	1,324	1,204	10%
	>13,500	30	14	44	8,301	6,029	38%	364	353	3%	25	25	3%	1,022	887	15%
	America Fabril	1		1	6,429			157			41			466		

Sources: Same as Table 2.

Table 9
Alternate Specifications of Cobb-Douglas Production Functions
Brazilian Cotton Textile Industry, 1866-1927

Unbalanced Panel Regressions on Entire Sample
T Statistics in Parentheses

Dependent Variable=Natural Log (Nominal Value of Production)

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7	Spec 8	Spec 9	Spec 10	Spec 11
Intercept	7.192	5.014	7.547	5.611	5.607	5.540	5.009	5.458	5.702	5.849	5.810
	(40.161)	(26.560)	(40.287)	(27.706)	27.4598	(27.141)	(25.213)	(26.505)	(25.427)	(25.231)	(24.906)
Ln(Spindles)--proxy for capital	0.335	0.356	0.283	0.314	0.315	0.321	0.346	0.315	0.292	0.284	0.281
	(7.548)	(9.422)	(6.330)	(8.315)	(8.290)	(8.499)	(8.993)	(8.316)	(7.875)	(7.641)	(7.576)
Ln(Workers)--proxy for labor	0.727	0.649	0.726	0.651	0.651	0.661	0.651	0.667	0.723	0.714	0.734
	(15.004)	(15.638)	(15.203)	(16.061)	(16.055)	(16.266)	(15.677)	(16.451)	(17.736)	(17.527)	(18.089)
Time		0.044		0.038	0.038	0.036	0.045	0.038	0.030	0.029	0.028
		(19.634)		(15.396)	(15.389)	(14.175)	(18.363)	(14.554)	(9.463)	(9.297)	(8.700)
Joint Stock--Dummy for Limited Liability Joint Stock Company			0.271	-1.161	-1.833	-1.137		-1.587		-0.968	-1.349
			(5.644)	(-3.832)	(-3.037)	(-3.761)		(-4.632)		(-2.970)	(-3.902)
Interaction between Time and Joint Stock				0.024	0.036	0.024		0.032		0.019	0.025
				(4.609)	(3.474)	(4.504)		(5.343)		(3.298)	(4.255)
Traded-dummy for firms listed in stock exchange markets					0.853						
					(1.286)						
Interaction Between Time and Traded					-0.015						
					(-1.274)						
Vintage-Dummy for age of firm						0.096		0.093			0.078
						(2.436)		(2.343)			(2.017)
Bonds--Dummy for Bonded Debt							0.391	1.089			1.501
							(1.199)	(3.067)			(4.115)
Interaction Between Time and Bonds							-0.006	-0.019			-0.028
							(-0.991)	(-3.102)			(-4.305)
Region--Dummy for Firms in States of MG, RJ, DF, SP									-0.947	-0.629	-0.973
									(-3.948)	(-2.402)	(-3.558)
Interaction Between Time and Region									0.022	0.016	0.022
									(5.220)	(3.440)	(4.567)
N	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029
Adjusted R2	0.73	0.80	0.74	0.81	0.81	0.81	0.80	0.81	0.82	0.82	0.82

Table 10

Alternate Specifications of Cobb Douglas Production Functions
to Explain Productivity Differentials between Joint Stock and Private Firms
Brazilian Cotton Textile Industry, 1866-1927

Unbalanced Panel Regressions on Various Samples

Dependent Variable=Natural Log (Nominal Value of Production/Workers)
T Statistics in Parentheses

	All Firms		Small Firms		Firms Reporting Meters				Small Firms Reporting meters			
	Spec 1	**Spec 2**	**Spec 3**	**Spec 4**	**Spec 5**	**Spec 6**	**Spec 7**	**Spec 8**	**Spec 9**	**Spec 10**	**Spec 11**	**Spec 12**
Intercept	5.014	5.611	5.290	5.837	5.482	5.949	4.093	3.650	4.892	5.784	3.680	3.228
	(26.560)	(27.706)	(19.871)	(21.166)	(22.948)	(23.534)	(10.227)	(9.237)	(7.471)	(15.542)	(6.936)	(6.227)
Ln(Spindles/Workers)--proxy for capital-labor ratio	0.356	0.314	0.332	0.289	0.432	0.381	0.319	0.367	0.499	0.446	0.382	0.434
	(9.422)	(8.315)	(6.664)	(5.867)	(8.053)	(7.089)	(5.954)	(6.844)	(3.734)	(6.120)	(5.320)	(6.081)
Ln(Workers)--proxy for firm size	0.005	-0.035	-0.016	-0.053	0.002	-0.038	-0.266	-0.227	0.047	-0.029	-0.272	-0.241
	(0.305)	(-1.832)	(-0.563)	(-1.842)	(0.082)	(-1.580)	(-5.870)	(-4.977)	(0.732)	(-0.716)	(-4.574)	(-4.046)
Time	0.044	0.038	0.042	0.037	0.034	0.031	0.028	0.032	0.036	0.030	0.026	0.029
	(19.634)	(15.396)	(16.468)	(13.670)	(12.657)	(10.701)	(9.722)	(12.069)	(6.043)	(9.342)	(8.401)	(9.678)
Joint Stock-Dummy for Limited Liability Joint Stock Company		-1.161		-1.616		-0.623	-1.048			-0.875	-1.313	
		(-3.832)		(-3.816)		(-1.433)	(-2.433)			(-1.296)	(-1.983)	
Interaction Between Time and Joint Stock		0.024		0.032		0.015	0.021			0.018	0.025	
		(4.609)		(4.341)		(1.988)	(2.950)			(1.622)	(2.269)	
Lnmeters--proxy for low quality output							0.245	0.240			0.270	0.272
							(5.891)	(5.749)			(5.430)	(5.479)
N	1029	1029	790	790	709	709	709	709	532	532	532	532
Adjusted R2	0.31	0.35	0.29	0.32	0.24	0.27	0.30	0.28	0.23	0.25	0.29	0.28

Table 11

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 2.