**Anpec - Área 2: História Econômica**

# Revisiting Import-Substituting Industrialisation in Post-War Brazil

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**Resumo**

Este artigo reavalia o período clássico da Industrialização Substitutiva de Importações (ISI) no Brasil, entre 1945 e 1979. Novos dados apresentados no texto mostram que a indústria brasileira alcançou taxas significativas de crescimento da produtividade durante os anos do pós-guerra, além de tornar-se tecnologicamente mais sofisticada quando são consideradas as exportações industriais e evidências de empresas e indústrias específicas. Ao mesmo tempo, a produtividade do trabalho no Brasil cresceu menos do que em outros países em processo de industrialização e industrializados a partir de meados da década de 1970. O desenvolvimento tecnológico foi lento e desigual, sendo a maioria das firmas relativamente atrasadas. De uma maneira geral, esses resultados sugerem que uma importante característica da industrialização brasileira foi o desenvolvimento de uma estrutura altamente heterogênea, antes de ineficiência generalizada e estagnação tecnológica vistas como típicas pela interpretação dominante da ISI na América Latina.

**Palavras-chave**: Industrialização Substitutiva de Importações; Produtividade; Tecnologia

**Abstract**

This article reassesses the classic period of Import-Substituting Industrialisation (ISI) in Brazil between 1945 and 1979. New data presented here show that Brazilian industry achieved significant labour productivity growth during the post-war years and became more technologically sophisticated, when measured by manufacturing exports and evidence of specific industries and firms. We also found that Brazil's labour productivity growth lagged behind what was achieved in other industrialising and developed countries from the mid-1970s. Technological advances were slow and uneven, and most firms relatively backward. Overall these results suggest that a highly heterogeneous structure became a major feature of Brazilian industrialisation, rather than widespread inefficiency and technological stagnation as argued by the dominant interpretation of ISI in Latin America.

**Key Words:** Import-Substituting Industrialisation; Productivity; Technology

**JEL Codes:** N16, N46, O25, C32

# Revisiting Import-Substituting Industrialisation in Post-War Brazil

This article reassesses the classic period of Import-Substituting Industrialisation (ISI) in Brazil during the post-World War II, by presenting new evidence about labour productivity, technological content of exports and selected firms and industries. Scholars have long been disputing the causes of the post-war story of boom and boost in Brazil and other major Latin American countries, in particular the nature of import-substituting industrialisation and its role in the post-1979 slowdown. Early in the 1960s a positive view of the achievements of industrialisation in Brazil and Latin America gave way to pessimism and mounting criticism (Hirschman, 1968, p. 1-4). 'Market critics', to use Werner Baer's words, pointed to the distortions caused by high and indiscriminate protection, subsidies and exchange controls in Latin American industrialising countries. According to these critics, the indiscriminate nature of import-substituting industrialisation led to the development of deeply inefficient and high-cost industries (Baer, 1972, p. 101-6). In their extreme versions, the record of ISI has been viewed in a very negative light: 'Latin America's history has been characterized by mediocre growth, rampant protectionism, very high inflation, low productivity growth, and successive crisis' (Edwards et al., 2007, p. 1) .

In this article, I argue, first, that there was significant labour productivity growth from 1945 through the 1970s in Brazilian industry; and, second, that there are signs of considerable technological improvement as gauged by manufacturing exports and the performance of industries and firms in Brazil after 1945. We also find, however, that Brazil's labour productivity growth was slower than in other industrialising and developed countries from the mid-1970s and that technological advance was uneven across firms and sectors, since most industrial companies used antiquated equipment, lacked technical expertise and turned out low-quality products. These results suggest that a highly heterogeneous structure became a major feature of Brazilian ISI in the post-war years, with uneven and mixed outcomes. Such conclusion departs from the dominant interpretation of ISI in Latin America that sees widespread inefficiency and technological stagnation as a distinctive feature of industrialisation in Latin America during the post-war years.

The article is organized in five sections within a time span which covers the heyday of import substitution policies, starting in 1945 with the end of the Second World War and ending in 1979 with the reversal of debt-led growth in Brazil. The second section reviews interpretations of ISI in Latin American, and the third presents an overview of the industrial transformation and estimates of labour productivity growth in the post-war years. The fourth section provides data on the technological content of exports. The fifth section looks into evidence from selected firms and industries. In the end, we draw conclusions about productivity and technological development in post-war Brazil.

## Some interpretations of ISI in Latin America

Market criticism of ISI was shared by scholars from different perspectives.[1] In the early 1960s, Santiago Macario, an economist at Economic Commission for Latin America (ECLA), provided a thorough and critical analysis of the sort of import-substitution policies pursued in Latin America. Macario pointed out that such policies allowed domestic firms to charge high prices and offered them little incentive to produce efficiently. Moreover, the indiscriminate protectionist policy hampered the development of manufacturing exports and increased external vulnerability, because of its negative impact upon productivity growth and competitiveness.[2] This point was similar to what was later argued by – in Stephen Haggard's words – 'neoclassical critics', who became highly influential from the early 1970s (Haggard, 1990, p. 10-13; Wade, 2004, p. 8-22).[3] But there remained major differences between ECLA and neoclassical views. Macario pointed out that the problem lay not with trade protection itself, but rather with the policy of indiscriminate trade barriers and import substitution at any cost (for example, regarding efficiency considerations) that prevailed in Brazil and other Latin American countries since the 1940s (Macario, 1964, p. 11). For their part, most neoclassical critics viewed government intervention in trade, exchange and credit markets, aiming at promoting the industrial sector, as the ultimate source of

[1] As acknowledged by Balassa (1970), p. 30-1, although not by Krueger (1997).

[2] Macario (1964), pp. 75-83. See also Prebisch (1963) and Hirschman (1968), pp. 2-3, note 4.

[3] For influential neoclassical critics, see Little and Scott (1970); Krueger (1978); Balassa (1982).

distortions and chronic problems in Latin American economic development. Although cautious about the available evidence regarding the dynamic effects from export orientation when compared to those from import substitution policies, neoclassical critics saw the sheltered industries and inward-oriented strategies as harmful to innovation and technical progress (Bhagwati, 1978, p. 193-7; Srinivasan and Bhagwati, 1989, p. 28-31).

More recently, economists and economic historians have been less cautious than earlier market critics by arguing that Latin America represents a conspicuous example of the failure of state-led, inward-oriented industrialisation. Low productivity growth and technological stagnation would be a straightforward and unavoidable outcome of import-substitution policies, in particular of high trade protection. Sebastian Edwards has consistently ascribed irregular economic growth, political instability and high inequality to the nature of ISI and its protectionist policies in Latin America (Edwards, 1993, p. 1358-1393; Edwards, 2009a; Edwards, 2009b). Victor Bulmer-Thomas, in his classic economic history of Latin America, pointed out that the problem with import-substituting industrialisation lay not in its excesses, but rather in its use of distorting policies (mainly trade protection) which generated deep-rooted inefficiency. By suppressing imports, there was no way of keeping 'the productive apparatus efficient and technologically up to date'. Thus, according to Bulmer-Thomas, '[t]he inward-looking model, particularly in the 1950s, is now seen as an aberration (...) although the excesses were often unnecessary the model – even in a less-distorted form – still cannot be defended' (Bulmer-Thomas, 1994, p. 281, 283). Stephen Haber noted that 'it is not clear […] that the increase in the *size* of Latin American industry necessarily translated into an increase in the *productivity* of Latin American industry'. Haber quotes estimates of substandard productivity growth (Total Factor Productivity) in Mexico and Argentina's manufacturing industry and seems to infer that they are a good description of the performance of Latin America in the post-war years. In his overall assessment, Haber argued that 'the ultimate outcome of import-substituting industrialisation (ISI) is as depicted in the standard literature: highly protected and woefully inefficient industries' (Haber, 2006, p. 538, 577-8).

This stagnationist hypothesis of ISI in Latin America has not gone unchallenged. Rosemary Thorp maintained that Latin America economic history shows 'a reality that is complex and contains both good and bad'. There were 'distortions, inefficiencies and lost opportunities' but there was also 'a radical transformation of infrastructure and institutions'. Industrial firms gradually acquired new skills and engaged in assimilating, adapting and developing new technologies (Thorp, 2006, p. 197; Cárdenas et al., 2001, p. 1-35). This view of a gradual learning process that did not preclude productivity growth and technological improvement has some support from case studies of individual industries in Brazil and other large Latin American economies. For example, Werner Baer's well-known estimates of costs and prices of steel products indicated that some Brazilian companies compared favourably to their counterparts in the United States during the 1960s (Baer, 1970, ch. 6). For the same period, Nathaniel Leff found that Brazilian companies in the heavy-engineering industry were competitive compared to imports (Leff, 1968, ch. 6). There is likewise evidence of significant productivity growth in other manufacturing industries, particularly in modern branches such as steel, metallurgical and motor vehicle parts. According to Teitel and Thoumi, increasing productivity in manufacturing, along with a reduction of the anti-export bias of trade policies, propelled manufactured exports from the 1960s (Teitel and Thoumi, 1986). The phenomenon of technology exports by Brazil and other developing countries from the 1970s is another piece of evidence that indicates technological advances in manufacturing (Lall, 1984, p. 471-80; Dahlman and Sercovich, 1984, p. 63-99; Teitel and Sercovich, 1984, p. 645-60; Sercovich, 1984, p. 575-90) . Thus, for the case of Brazil, William Tyler argued that in 'those industries where post-war industrial growth and import substitution have been the greatest, e.g. steel, machinery, and transport equipment, by the mid-1970s reasonable international competitiveness has been attained in a large number of lines of production' (Tyler, 1976, p. 867). Despite such evidence of technological advance and productivity growth, however, the stagnationist hypothesis of ISI has been established as the mainstream view of industrialisation in Latin America in the post-war years.

At first sight it may be surprising that such contrasting views about efficiency have been drawn from the same reality of Brazilian industrialisation. I argue in the following sections that the experience of economic growth in Brazil was marked by two facts that complicate analysis and help make an assessment of industrial performance elusive. First, there was a wide range of productivity and

technological levels in firms of the same industry (Dahlman and Frischtak, 1993, p. 414-50; Tyler, 1976, p. 868). Second, manufacturing firms were heavily affected by the collapse of debt-led growth in Brazil in the early 1980s. The macroeconomic environment deteriorated sharply, policies were discontinued, firms cut investments so that industrial conditions before and after the debt crisis changed radically (Dahlman and Frischtak, 1993, p. 420-5; Fishlow, 1980). The role of these two factors is even more important given the fact that detailed historical research on technology and productivity of Brazilian manufacturing firms and industries is still relatively scant. The following sections aim at contributing to fill this gap.

### Industrial change, trade protection and productivity growth

Scholars have long shown that Brazil's economy growth in the post-World War II was largely a result of rapid expansion of industry (Fishlow, 1980; Tavares, 1972; Malan et al., 1980; Maddison, 1992; Baer, 2001). The average growth of industrial output between 1945 and 1979 reached 8.8 per annum. The magnitude of structural change in the post-war years can be seen, first, by the share of the industrial sector in the Gross Domestic Product (GDP), which grew from 24.1 percent in 1950 to 40.9 percent in 1980 – whereas agriculture declined from 24.3 percent in 1950 to 10.1 percent in 1980. Second, modern industries such as machinery, electrical materials, transport equipment and chemicals performed particularly well. Their share in manufacturing output jumped from 12.6 percent in 1949 to 43.6 percent in 1980. By contrast, traditional manufacturing experienced a sharp relative decline, the most noticeable cases being those of the food and textile industries, which saw a reduction in their share of manufacturing output from 31.9 and 18.6 percent in 1949 to 13.9 and 6.4 percent in 1980, respectively.[4]

Rapid industrial growth and structural change in Brazil were stimulated by a diversified mix of economic policies, which included multiple exchange rates, quantitative import restrictions, direct foreign exchange controls, tariffs, and fiscal and credit subsidies. Despite the myriad policy tools adopted in Brazil after World War II, the *rationale* behind them was already relatively clear in the 1950s. Protection of industry should be kept at a high level, both to redress balance-of-payments imbalances and to foster import substitution of all ranges of goods which could be replaced by those of domestic production (Macario, 1964). Estimates of trade protection corroborate this view, as can be seen in Table 1.

*Table 1*. Nominal protection in the manufacturing industry, Brazil and European Economic Community, *c*. 1960 (percent)[a]

| Industries | Brazil[b] | EEC[c] |
|---|---|---|
| Manufacturing industry (97 products)[d] | 165 | 17 |
| Non-metallic minerals (2 products) | 33 | 10 |
| Metallurgy (12 products) | 79 | 7 |
| Machinery (20 products) | 73 | 11 |
| Electrical materials (10 products) | 302 | 17 |
| Transport equipment (10 products) | 170 | 17 |
| Furniture (1 product) | 336 | 18 |
| Paper and products (1 product) | 36 | 6 |
| Rubber (2 products) | 106 | 21 |
| Leather (1 product) | 336 | 19 |
| Chemical and pharmaceutical products (13 products) | 109 | 11 |
| Perfumes and soaps (1 product) | 325 | 19 |
| Textiles (4 products) | 248 | 9 |
| Clothing and footwear (3 products) | 345 | 21 |
| Food products (16 products) | 238 | 37 |
| Beverages (1 product) | 346 | 13 |

*Source*: Macario (1964), Annex III. Industries reclassified by the author.

[4] Data elabourated by the author from Brazil (1990), p. 125-27, 386. Figures of industry's share of GDP are measured in current prices. For a detailed analysis of structural change in Brazil, see Baer et al. (1987).

*Notes*:

[a] *Ad valorem* incidence of duties and charges in Brazil and EEC. Products included are 'the most representative of the production and trade of the countries concerned', Macario (1964), p. 74.

[b] Duties and charges in March 1962.

[c] Duties and charges *c*. 1960.

[d] Manufacturing industry averages were weighted by the number of products in each group.

As Table 1 shows, by the early 1960s nominal protection (measured by charges and duties on imports) in Brazil was very high, with an average of 165 percent over import prices in the manufacturing industry, compared to an average of 17 percent in the European Economic Community (EEC). Long-established industries, such as the textile industry, enjoyed particularly high protection rate (248 percent over import prices) and defied the logic of infant industry, which commended only a transitory period of protection for new industries, before being left to compete with imports. This pattern is also evident in other traditional industries: for example, food products, with an average of 238 percent over import prices. Also, modern industries benefited from high trade protection, even though well-established foreign companies had a substantial share in these new branches of the manufacturing industry.[5] A case in point was the production of electrical consumer goods and motor vehicles, in which the incidence of duties and charges on imports was over 300 percent. The logic of the protection policy was also apparent in the industries with relatively lower levels of nominal protection, such as metallurgy and machinery (79 and 73 percent, respectively), since their duties and charges too were high by international standards (compared to the EEC, for example) (Macario, 1964, Annex III).[6]

These trends shown by data on nominal protection are confirmed by estimates of effective protection; that is, with value added taken into account, along with final prices, for calculating trade protection. Effective rates of protection were even greater than nominal rates in Brazil's manufacturing industry. Again, the most favoured industries were those which were already mature in the 1960s. In 1966, nominal protection was 181 percent and effective protection 379 percent for textiles, and 226 percent and 337 percent for clothing, respectively. In the manufacturing sector nominal and effective rates of protection achieved 96 and 113 percent, respectively. In 1954, the same indicators for the manufacturing sector in Norway, for example, were just 8 percent (Balassa, 1971, p. 54; Bergsman and Malan, 1971, p. 120).

This is the sort of evidence that has been used to support the view that trade policies generated widespread inefficiency and technological stagnation, despite high industrial growth in post-war Brazil (Edwards, 2009b; Bulmer-Thomas, 1994; Haber, 2006). However, what does the evidence about productivity growth and technology in Brazil's manufacturing reveal? We look initially into new data on labour productivity for the period 1945-1979, constructed by using interpolation and backward extrapolation of available statistics.[7]

Table 2 shows the annual average rates of growth of labour productivity in eighteen industries as well as in Brazil's manufacturing industry as a whole, in different periods of the post-war years. The yearly average rate of labour productivity growth in Brazilian manufacturing industry reached 5.9 percent between 1945 and 1979. The average growth rate was lower in the period 1961-1968 (3.8%) when compared to those from the other two periods in which the series was split in Table 2: annual growth rates of 6.6% in 1945-1961 and 6.0% in 1968-1979. It seems that macroeconomic instability and relatively low economic growth during part of the 1960s negatively affected industrial labour productivity.[8] However, table 2 also shows that individual industries exhibited a different pattern of growth through these periods,

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[5] Differently from what Sebastian Edwards states: 'These two approaches [promoting import substitution or exports] differed in terms of the role given to foreign capital – the import substitution model restricted it, while the export-oriented alternative encouraged it'. Sebastian Edwards (2009b), p. 575.

[6] However, Leff argued that tariffs and restrictions were not usually applied to equipment imports at the time (Leff, 1968, p. 134-42).

[7] Details about these estimates are described in the Appendix.

[8] Brazil's industrial output growth between 1961 and 1968 was 5.9%, compared to 9.8% in 1945-1961 and 9.9% in 1968-1979. For Brazil's macroeconomic performance in the 1960s, see Wells (1977).

as in the cases of machinery, non-metallic minerals, tobacco, furniture, printing and publishing, miscellaneous, leather, and wood.[9]

*Table 2*. Growth of labour productivity by industrial sectors, Brazil, 1945-1979 (percent growth)

| *Industries* | 1945-1961 | 1961-1968 | 1968-1979 | 1945-1979 |
|---|---|---|---|---|
| Textiles | 6.2 | 4.6 | 15.5 | 9.2 |
| Paper and products | 6.6 | 5.2 | 7.8 | 7.1 |
| Rubber | 8.8 | 2.6 | 6.2 | 6.8 |
| Clothing and footwear | 4.5 | 4.0 | 11.6 | 6.8 |
| Tobacco | 9.6 | 7.0 | 5.0 | 6.8 |
| Transport equipment | 8.7 | -1.9 | 7.3 | 6.5 |
| Furniture | 5.8 | 9.6 | 7.3 | 6.5 |
| Non-metallic minerals | 5.4 | 8.6 | 6.8 | 6.3 |
| Miscellaneous | 6.7 | 6.1 | 5.5 | 6.0 |
| Printing and publishing | 4.4 | 6.9 | 7.3 | 5.9 |
| Chemical and pharmaceutical products | 7.1 | 3.5 | 5.6 | 5.6 |
| Electrical and communications materials | 5.4 | 2.5 | 8.2 | 5.6 |
| Metallurgy | 6.1 | 2.4 | 7.6 | 5.5 |
| Machinery | 4.4 | 5.9 | 6.0 | 5.5 |
| Wood | 4.1 | 6.0 | 4.7 | 4.3 |
| Food products | 4.7 | 3.3 | 4.2 | 4.3 |
| Beverages | 4.7 | -0.4 | 6.0 | 3.9 |
| Leather | 4.4 | 5.1 | 2.1 | 3.4 |
| Manufacturing industry | 6.6 | 3.8 | 6.0 | 5.9 |
| Standard deviation | 1,0210 | 2,6049 | 1,8090 | 0,9683 |
| Coefficient of variation | 0,1697 | 0,5862 | 0,2625 | 0,1642 |

*Sources*: see Appendix.

The results of labour productivity growth presented in Table 2 are very significant when compared to the performance of other developing and even developed countries. International comparisons by Bart van Ark and Marcel Timmer using estimates drawn from national industrial census or surveys, and therefore similar to the data presented here, show that Brazil achieved relatively high productivity levels by the 1960s. Brazil's labour productivity was 54.1 percent of the United States's in 1960 and 56.0 percent in 1973 – compared, for example, to 11.3 and 17.1 percent in Korea; 25.8 and 43.4 percent in Spain and 48.3 and 53.4 percent in the United Kingdom, respectively (van Ark and Timmer, 2001, p. 48, table 2).[10] At the same time, these figures indicate that the speed of Brazil's catch up was slower than that of other countries between 1960 and 1973. Brazil's catch-up with the levels of US labour productivity was particularly strong during the 1950s, and continued throughout the 1960s up to the mid-1970s, when started to reverse (van Ark, 1993, pp. 92-7; Appendix, table IV.4). Indeed, Brazil's labour productivity

[9] Incidentally, standard deviation and coefficient of variation in Table 2 show that dispersion in labour productivity growth rates increased in 1961-1968 and then declined sharply in 1968-1979.

[10] van Ark and Timmer's labour productivity data refer to the value added per person employed in manufacturing. Data for Korea and Taiwan refer to 1963 and 1973. Some international comparisons of Total Factor Productivity are even more favorable to Brazil: according to estimates by Ferreira et al, TFP in Brazil achieved 83% of the US level in 1960, 88% in 1970 and 107% in 1975, when started a long-run decline (73% in 2000) (Ferreira et al, 2009, p. 6).

level dropped to only 35.9 percent of the US level in 1998 – whereas Korea (43.1 percent), for example, continued to catch up. As argued by van Ark and Timmer, the economic crisis ignited by the collapse of the debt-led growth in the 1980s severely hit the productivity performance of the Brazilian industry, although it is also clear that labour productivity growth had already lagged behind other emerging economies during the 1970s (van Ark and Timmer, 2001).[11]

It is reasonable to expect that the relatively high productivity growth in Brazilian manufacturing industry stemmed from the reallocation of resources among sectors, in a process of structural change which was investigated by Arthur Lewis and Simon Kuznets (Syrquin, 1988, vol. 1, p. 203-73). As we saw earlier, modern industries increased their share in total manufacturing in relation to traditional industries in the post-war years. Such structural change in the industrial sector, when leading to a reallocation of capital and labour from lower to higher productivity growth branches, may become the major cause of the increase in aggregate labour productivity of the manufacturing industry. In this situation, intra-branch growth in labour productivity, explained by more efficient use of resources by firms, turns out to be only a secondary or irrelevant factor in explaining aggregate productivity growth.

We can estimate the impact of both structural change and intra-industry productivity on aggregate productivity growth by using the shift-share analysis, originally proposed by Solomon Fabricant, extended by W.E.G. Salter, and applied in recent studies of industrial growth (Fabricant, 1942; Salter, 1960; Fagerberg, 2000; Timmer and Adam Szirmai, 2000; Peneder, 2003). The shift-share analysis decomposes the growth of aggregate labour productivity into three specific effects:

$$\text{Growth}\,(LP_T) = \frac{LP_{T,t} - LP_{T,t-1}}{LP_{T,t-1}}$$

$$= \frac{\overbrace{\sum_{i=1}^{n} S_{i,t-1}(LP_{i,t} - LP_{i,t-1})}^{\text{(I) within-industry effect}} + \overbrace{\sum_{i=1}^{n} LP_{i,t-1}(S_{i,t} - S_{i,t-1})}^{\text{(II) static shift effect}} + \overbrace{\sum_{i=1}^{n} (LP_{i,t} - LP_{i,t-1})(S_{i,t} - S_{i,t-1})}^{\text{(III) dynamic shift}}}{LP_{T,t-1}} \qquad (1)$$

where $LP$ is the labour productivity, $i$ an individual industry, $Si$ the share of industry $i$ in total manufacturing, $T$ the sum over industries $i$, $t-1$ the initial year and $t$ the final year.

The first component (within-industry effect) measures the contribution of productivity growth within individual industries resulting from factors such as learning by doing, higher capital intensity and shift-effects among firms. The other two terms on the right-hand side of equation (1) refer to structural change. The second term (static effect) shows how much a shift of labour towards industries with a higher level of labour productivity affects aggregate labour productivity. If industries with a higher level of labour productivity increase their share in total employment, this effect will be positive. The third term (dynamic effect) measures the combined effect of changes in labour productivity of individual industries and the shifts of their relative shares in total manufacturing. If industries with higher rates of labour productivity growth also increase their share in total manufacturing employment, then this effect will be positive.

Table 3 shows the results of the shift-share analysis for the Brazilian manufacturing industry.[12] The post-war years are divided into three sub-periods in order to capture possible different patterns in

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[11] Astorga, Bergés and Fitzgerald (2003) also showed that 'aggregate productivity' (measured by the PPP adjusted GDP divided by the economically active population) collapsed in the 1980s. Likewise, Prados de la Escosura (2007, p. 20-25) found that the 1980s marked a major breakthrough in the trend of per capita GDP growth in Latin America. Estimates of Total Factor Productivity in Latin America have also shown a sharp fall during the 1980s. See, for example, Ferreira, Pessôa and Veloso (2009); Elías (1990); Fajnzylber and Lederman (2000); Hofman (2000); Loayza, Fajnzylber and Calderón (2005).

[12] We follow the presentation by Timmer and Szirmai (2000), p. 377.

labour productivity growth and structural change. First, the period between 1945 and 1961 comprises the golden age of 'developmentalism', when the annual average growth of GDP and industrial product achieved 7.3 percent and 9.8 percent, respectively. Second, economic growth faltered from 1961 to 1968 (GDP, 5.3 percent; industrial product, 5.9 percent). Third, there was another boost in the average growth of GDP (9.0 percent) and industrial product (9.9 percent) between 1968 and 1979.[13]

*Table 3*. Decomposition of labour productivity growth in manufacturing, Brazil, 1945-1979 (percent)

| Labour productivity growth | | Percentage of labour productivity growth explained by: | | | |
|---|---|---|---|---|---|
| Periods | Annual growth (percent) | Within-industry effect | Static shift effect | Dynamic shift effect | Total effect |
| 1945-1961 | 6.6 | 91.5 | 4.5 | 4.0 | 100.0 |
| 1961-1968 | 3.8 | 90.3 | 13.8 | -4.1 | 100.0 |
| 1968-1979 | 6.0 | 113.1 | -0.6 | -12.6 | 100.0 |
| 1945-1979 | 5.9 | 116.2 | 1.6 | -17.8 | 100.0 |

Sources: see Appendix.

During the golden age of developmentalism (1945-1961), annual growth of labour productivity was 6.6 percent and structural change explained 8.5 percent of the aggregate productivity growth. Both static (4.5 percent) and dynamic-shift (4.0 percent) effects were present. Thus a shift of labour to more productive industries and an increasing share of fast growing industries in total employment had some impact upon productivity in Brazilian manufacturing. Still, productivity change within industries was the major cause of manufacturing productivity increase – 91.5 percent of the aggregate productivity growth in the period.

Labour productivity growth slowed down between 1961 and 1968 (3.8 percent, annual average) and structural change explained 9.7 percent of the aggregate productivity growth. As a matter of fact, the transference of labor to higher productivity industries (static-shift effect) explained 13.8 percent of aggregate productivity growth, but a declining share of fast growing branches in total employment led to a negative dynamic-shift effect (-4.1 percent) that reduced the overall impact of structural change. Thus within-industry productivity increases explained 90.3 percent of aggregate productivity growth at the time.

During the high-growth years of 1968-1979, average growth of labour productivity reached 6.0 percent, an outcome explained by within-industry productivity growth (113.1 percent) alone, since the transference of labour to branches with lower levels of labour productivity (static-shift effect, -0.6 percent) and the decreasing share of fast growing industries (dynamic-shift effect, -12.6 percent) contributed negatively to aggregate productivity growth.

For the whole period productivity advances within industries dominated as the source of aggregate labour productivity growth. Table 3 shows that between 1945 and 1979 the structural change effect in Brazil's manufacturing industry was negative (-16.2 percent). In particular, the strongly negative dynamic-shift effect (-17.8) indicates the presence of a structural burden on aggregate productivity resulting from unbalanced growth – the so-called Baumol hypothesis (Baumol, 1967). Productivity increases within individual industries explained 116.2 percent of the aggregate productivity growth.

Overall, the data on productivity growth lend support to a qualified view of the efficiency performance of import-substitution industrialisation in post-war Brazil. This country achieved high labour productivity levels in the 1960s, although it lagged behind other industrialising and developed countries in the following years, in particular from the mid-1970s. At the same time, structural change had a minor role in explaining productivity growth; the chief determinant of labour productivity being the more efficient use of resources by firms.

[13] Calculated from Abreu (1990), Appendix.

**Technological content of exports**

Another evidence for the performance of import-substituting industrialisation in Brazil is the technological content of exports. The assumption is that the export structure of a country reflects domestic learning and innovation by firms and industries (Dosi, Pavitt and Soete, 1990; Dalum, 1992; Krugman, 1995; Montobbio and Rampa, 2005). We use a typology elaborated by Sanjaya Lall that is roughly similar to the classification of the United Nations Conference on Trade and Development (Lall, 2000; UNCTAD, 2002, ch. 3, annex 1). The first group, 'Primary Products', comprises agricultural and extractive exported goods with no or very little industrial processing. Manufactured products in turn are grouped into four different categories. 'Resource Based Manufactures' are processed natural resources, usually of a simple, labour-intensive and low-skill type. 'Low Technology Manufactures' consist of goods with stable and well-diffused technologies, labour intensive and low-skill content. 'Medium Technology Manufactures' include products intensive in capital, technology and labour skills. 'High Technology Manufactures' are characterized by rapid technological progress, high R&D content and sophisticated skills. Requirements including complex infra-structure, high level of labour and management skills, and interaction with research institutions made technology development in this category especially difficult for newly industrialising countries.

New estimates of the technology content of manufactured exports are shown in Table 4. We see clearly that Brazil was largely dependent upon primary exports throughout the period 1945-1979. Shares of primary products in total exports were above 50 percent in most of the post-war years; they were particularly high in late 1940s and early 1950s, when coffee prices experienced a boom in international markets.

*Table 4*. Manufactured exports classified by technological categories, Brazil, 1945-1979 (percent)

| *Year* | *Exports of Primary Products* | *Exports of Manufactured Products* | | | | |
|---|---|---|---|---|---|---|
| | *(1)* | *Resource Based Manufactures (2)* | *Low Technology Manufactures (3)* | *Medium Technology Manufactures (4)* | *High Technology Manufactures (5)* | *Total Manufactured Exports (6)=(2+3+4+5)* |
| 1945 | 64.5 | 15.7 | 16.7 | 2.2 | 0.9 | 35.5 |
| 1946 | 75.1 | 16.4 | 6.9 | 1.0 | 0.6 | 24.9 |
| 1947 | 78.2 | 13.2 | 7.2 | 1.0 | 0.4 | 21.8 |
| 1948 | 86.0 | 10.1 | 3.0 | 0.7 | 0.3 | 14.0 |
| 1949 | 89.3 | 9.2 | 1.1 | 0.2 | 0.1 | 10.7 |
| 1950 | 87.7 | 9.8 | 1.9 | 0.5 | 0.1 | 12.3 |
| 1951 | 89.7 | 10.0 | 0.1 | 0.2 | 0.04 | 10.3 |
| 1952 | 91.5 | 8.1 | 0.1 | 0.2 | 0.04 | 8.5 |
| 1953 | 84.9 | 14.5 | 0.2 | 0.5 | 0.03 | 15.1 |
| 1954 | 89.3 | 9.7 | 0.2 | 0.7 | 0.02 | 10.7 |
| 1955 | 79.4 | 19.7 | 0.2 | 0.6 | 0.1 | 20.6 |
| 1956 | 76.3 | 22.8 | 0.4 | 0.4 | 0.1 | 23.7 |
| 1957 | 77.1 | 22.1 | 0.3 | 0.4 | 0.1 | 22.9 |
| 1958 | 76.3 | 22.5 | 0.6 | 0.6 | 0.1 | 23.7 |
| 1959 | 74.1 | 23.8 | 0.3 | 1.6 | 0.2 | 25.9 |
| 1960 | 75.5 | 22.2 | 0.4 | 1.7 | 0.3 | 24.5 |
| 1961 | 75.3 | 22.4 | 0.4 | 1.5 | 0.3 | 24.7 |
| 1962 | 74.0 | 21.7 | 1.3 | 2.6 | 0.4 | 26.0 |
| 1963 | 68.8 | 24.5 | 2.9 | 3.2 | 0.5 | 31.2 |
| 1964 | 70.6 | 23.4 | 2.8 | 2.5 | 0.8 | 29.4 |
| 1965 | 68.3 | 23.2 | 3.3 | 3.7 | 1.5 | 31.7 |
| 1966 | 70.5 | 23.4 | 2.8 | 2.5 | 0.8 | 29.5 |

| Year | Exports of Primary Products | Exports of Manufactured Products | | | | |
|---|---|---|---|---|---|---|
| | | Resource Based Manufactures | Low Technology Manufactures | Medium Technology Manufactures | High Technology Manufactures | Total Manufactured Exports |
| | (1) | (2) | (3) | (4) | (5) | (6)=(2+3+4+5) |
| 1967 | 68.3 | 23.2 | 3.3 | 3.7 | 1.5 | 31.7 |
| 1968 | 68.0 | 25.5 | 2.4 | 2.8 | 1.3 | 32.0 |
| 1969 | 67.2 | 25.4 | 3.0 | 3.0 | 1.4 | 32.8 |
| 1970 | 63.3 | 26.0 | 4.6 | 4.4 | 1.7 | 36.7 |
| 1971 | 51.9 | 37.4 | 4.4 | 4.8 | 1.5 | 48.1 |
| 1972 | 50.7 | 35.1 | 6.8 | 6.2 | 1.2 | 49.3 |
| 1973 | 53.8 | 30.7 | 7.7 | 6.7 | 1.1 | 46.2 |
| 1974 | 44.0 | 38.9 | 5.3 | 8.6 | 3.2 | 56.0 |
| 1975 | 44.6 | 35.7 | 5.7 | 11.3 | 2.7 | 55.4 |
| 1976 | 57.1 | 26.0 | 6.8 | 7.9 | 2.2 | 42.9 |
| 1977 | 53.0 | 25.9 | 7.7 | 10.5 | 2.9 | 47.0 |
| 1978 | 52.1 | 24.4 | 8.4 | 11.7 | 3.4 | 47.9 |
| 1979 | 42.4 | 23.5 | 11.0 | 19.1 | 4.0 | 57.6 |

*Source*: original export data from Brazil, *Anuário Estatístico do Brasil*, various years, classified by the author as described in the text.

Resource-based products were the main category of manufactured exports during the post-war years. From 1953 to 1963, the share of resource based products in manufactured exports was more than 90 percent. The high share of low technology manufactures in 1945 (47 percent) owed to the textile products, which had increased their participation in foreign markets after the collapse of traditional suppliers during the war. However, that increase was short-lived and textile exports dropped sharply in the years that followed. By 1953 textile exports were nearly inexistent.

If exports are taken as a proxy of technological development, such data clearly suggest that Brazil's industrial sector was dominantly labour intensive, low skill and technologically simple. This seems to be a reasonable generalization of post-war industrialisation in Brazil that conforms with other quantitative and qualitative assessments. Nevertheless, other trends also emerged during this time, the most important being that more sophisticated products began to increase their share in manufactured exports (Teitel and Thoumi, 1986; Dahlman and Frischtak, 1993).

The emergence of new branches and products can be initially identified in the low technology category and, more importantly, in medium technology category. That exports of low technology products fell so sharply after 1945 suggests serious problems of efficiency, which apparently only began to be overcome in the early 1960s. A more consistent performance was that of medium technology exports, whose export shares steadily increased from the end of the 1950s. High technology products, in turn, had the lowest share of total manufactured exports.

These results clearly shows the limited technological capabilities of Brazil's industrial structure; at the same time, the results are also relevant when placed in the context of the highly discriminatory policy against exports prevailing in post-war Brazil. The bias against exports was expressed by tariffs and quotas on inputs which raised the cost (and reduced the value added) of export industries compared to import-substituting industries. Overvalued exchange rates meant that export industries earned less in domestic currency than they could in a hypothetical free-trade situation. There is evidence that discrimination against export industries in Brazil achieved some of the highest levels observed among developing countries in the 1950s and 1960s. In 1966, for example, eight out of 21 manufactured products in Brazil would have had negative value added if they had been exported: textiles, and leather production, for example (Bergsman and Malan, 1971, p. 120; Balassa, 1971, p. 71-88; Balassa, 1979). Export biases like these were a major cause of the slow response by manufactured exports to the otherwise fast

industrialisation in Brazil. As argued by Teitel and Thoumi, 'such was apparently not the case for the major Asian SICs, which from the outset relied more for their industrial growth on attaining substantial exports of labour-intensive products than on the growth of domestic demand' (Teitel and Thoumi, 1986, p. 458). On the other hand, that manufactured exports expanded and diversified in such an adverse context seems to be further evidence of technological learning in Brazilian industry after 1945.

The same data as those used in Table 4 may be examined in a more disaggregated form in order to add further evidence on the diversification of manufacturing exports. Table 5 shows the relative shares of individual classes of products in total exports according to technological categories in 1945, 1960, 1973. In the case of resource-based manufactures, simply worked wood was among the major exports in the three years selected, although its relative share fell over the same period. In its place, new products such as sugar and iron ore became the chief manufactures sold abroad in the resource-based category. Also, exports of refined petroleum products seem to indicate the development of more sophisticated manufacturing in the wake of the import-substituting policies implemented during the 1950s.

*Table 5*. Exported products by technology categories, Brazil, 1945, 1960 and 1973

| *Year* | *Groups of exported products*[a] | *Share (percent)*[b] |
|---|---|---|
| | Resource based manufactures | |
| 1945 | Wood, simply worked, and railway sleepers of wood (248) | 21.4 |
| | Animal and vegetable oils and fats, processed and waxes (431) | 15.7 |
| | Meat and edible offal, prepared/preserved, fish extracts (014) | 10.9 |
| | Pearls, precious and semi-precious stones, unworked/worked (667) | 9.0 |
| | Other fixed vegetable oils, fluid or solid, crude (424) | 7.6 |
| | *Total* | *64.5* |
| 1960 | Sugar and honey (061) | 20.5 |
| | Iron ores and concentrates (281) | 18.9 |
| | Wood, simply worked, and railway sleepers of wood (248) | 16.6 |
| | Vegetable textile fibers and waste of such fibers (265) | 8.3 |
| | Animal and vegetable oils and fats, processed and waxes (431) | 6.8 |
| | *Total* | *71.1* |
| 1973 | Iron ores and concentrates (281) | 33.8 |
| | Sugar and honey (061) | 26.3 |
| | Wood, simply worked, and railway sleepers of wood (248) | 7.8 |
| | Other fixed vegetable oils, fluid or solid, crude (424) | 5.7 |
| | Meat and edible offal, prepared/preserved, fish extracts (014) | 3.7 |
| | Petroleum products, refined (334) | 3.7 |
| | *Total* | *81.0* |
| | Low technology manufactures | |
| 1945 | Cotton fabrics, woven (652) | 72.3 |
| | Leather (611) | 8.1 |
| | Textile yarn (651) | 7.6 |
| | Clothing accessories of textile fabrics (847) | 3.9 |
| | Textile fabrics, woven, other than cotton/man-made fibers (654) | 3.0 |
| | *Total* | *95.0* |
| 1960 | Cotton fabrics, woven (652) | 41.2 |
| | Textile yarn (651) | 17.6 |
| | Leather (611) | 15.7 |
| | Structures and parts of structures, iron, steel and aluminium (691) | 10.4 |
| | Iron and steel bars, rods, angles, shapes and sections (673) | 8.8 |
| | *Total* | *93.7* |

| *Year* | *Groups of exported products*[a] | *Share (percent)*[b] |
|---|---|---|
| | Resource based manufactures | |
| 1973 | Footwear (851) | 20.2 |
| | n.c. (various)[c] | 17.4 |
| | Leather (611) | 9.9 |
| | Made-up articles, wholly/chiefly of textile materials (658) | 4.7 |
| | Universals, plates and sheets, of iron or steel (674) | 3.9 |
| | *Total* | *56.0* |
| | Medium technology manufactures | |
| 1945 | Alcohols, phenols, phenol-alcohols and their derivatives (512) | 53.1 |
| | n.c. (various)[d] | 16.6 |
| | Fabrics, woven, of man-made fibers (653) | 13.2 |
| | Pig iron, spiegeleisen, sponge iron, iron or steel (671) | 9.2 |
| | Tubes, pipes and fitting, of iron and steel (678) | 7.7 |
| | *Total* | *100.0* |
| 1960 | Alcohols, phenols, phenol-alcohols and their derivatives (512) | 56.1 |
| | n.c. (various)[e] | 10.1 |
| | Pig iron, spiegeleisen, sponge iron, iron or steel (671) | 9.5 |
| | Textile and leather machinery and parts (784) | 5.2 |
| | Food processing machines and parts (727) | 4.1 |
| | *Total* | *84.9* |
| 1973 | n.c. (various)[f] | 30.2 |
| | Pig iron, spiegeleisen, sponge iron, iron or steel (671) | 11.6 |
| | Alcohols, phenols, phenol-alcohols and their derivatives (512) | 8.4 |
| | Fabrics, woven, of man-made fibers (653) | 7.3 |
| | Parts and accessories of vehicles (784) | 5.0 |
| | *Total* | *62.5* |
| | High technology manufactures | |
| 1945 | Medicinal and pharmaceutical products (541) | 100.0 |
| | *Total* | *100.0* |
| 1960 | Medicinal and pharmaceutical products (541) | 89.0 |
| | Aircraft and associated equipment and parts (792) | 11.0 |
| | *Total* | *100.0* |
| 1973 | Office machines (751) | 25.0 |
| | Automatic data processing machines and units thereof (752) | 24.6 |
| | Thermionic, cold and photo-cathode valves, tubes, parts (776) | 13.8 |
| | Medicinal and pharmaceutical products (541) | 12.1 |
| | Rotating electric plant and parts (716) | 6.0 |
| | *Total* | *81.5* |

*Notes*:

(a) Numbers between parentheses correspond to the three-digit United Nations' Standard Industrial Trade Classification (second revision): SITC classification, Rev. 2 (1976). All classifications were made by the author.

(b) Share of the five most important products in each technological category.

(c) Other synthetic and artificial textiles; Other tapestry, pile, lacework, etc. textiles; Other clothing and accessories; Other footwear, leggings, gaiters and the like; Other cast iron and steel; Other hand and machine tools, cutlery; Other manufactures of metal; Other diverse manufactures.

(d) Machines, apparatus, tools and utensils.

(e) Other machines and vehicles, parts.

(f) Other organic chemicals; Other soap, cleansing, polishing products, lubricants, artificial waxes, etc.; Other diverse chemical products; rubber and plastic manufactures for domestic use; Other boilers, machinery, mechanical apparatus and appliances; Other electrical machinery, apparatus and appliances; Other motor and not-motorized vehicles; Other optical, photograph, medical, meters, counters, measuring and checking appliances.

*Sources*: same as Table 4.

Two important facts about the low technology manufactured exports can be inferred from Table 5. First, it is possible to see that the puzzle of fast-declining exports in this category between 1945 and 1953 (see Table 4) was mainly related to the textile industry. Textiles achieved 86.8 percent of low technology exports and 40.7 percent of all manufactured exports in 1945 but dropped to virtually no sales abroad in 1953. After increasing exports during World War II, the Brazilian textile industry was unable to compete in price and quality with international producers (such as Japan) when markets were restored. Exports of textile yarn and cotton fabrics only started to recover moderately in the second-half of the 1950s, as a result of exchange incentives and sweeping changes in work organization and investments in automatic machinery prompted by the crisis in the immediate post-war years (Stein, 1957, ch. 11; Colistete, 2001, p. 132-4).

Second, there was a clear diversification of low technology exported manufactures from the end of the 1950s. In 1945 and 1960, five classes of products made up more than 90 percent of all low technology exports, but by 1973 their share had dropped to 56 percent. Another sign of diversification is the group of non-classified (n.c.) manufactures, with 17.4 percent of the category's exports (Table 5). The type of products comprised in this group gives an idea of the rapid diversification of low technology manufactures: synthetic and artificial textiles, cast iron and steel, hand and machine tools, manufactures of metal and diverse manufactures. New manufactures such as footwear and steel and iron products appeared in external markets around the end of the 1950s.

Exports of medium technology products showed a similar trend towards diversification and more complex products. Alcohols, phenols, phenol-alcohols predominated in the 1940s and 1950s, but pig iron, manufactures from iron and steel, man-made fabrics, machinery and parts began to play an important role in medium technology exports. Diversification of exports is illustrated by the declining share of Alcohols, phenols, phenol-alcohols and the increasing participation of non-classified products (n.c.) in the three years selected, since the n.c. group consisted largely of machines, tools and parts (see Table 5). Brazil's export data already recorded exports of textile, leather, food processing and printing machinery and their parts, as well as mechanical handling equipment (lifts and elevators), during the 1950s. Among the exported products in the early 1960s were steam boilers, internal combustion piston engines, non-electric engines and motors, agricultural machinery, paper and pulp machinery, machine-tools, equipment for distributing electricity, passenger motor cars, motor vehicles for transport of goods and materials, and parts and accessories of motor vehicles in general. In all these cases, production processes were sophisticated and required high levels of engineering and designing capabilities, a skilled labour force and an ability to assimilate, adapt and improve existing technologies.

Finally, exports of high technology manufactures also witnessed diversification despite their low shares in total exports throughout the post-war years. Medicinal and pharmaceutical products were the only high technology goods exported from 1945. These exports reflect earlier capabilities developed in the production of alkaloids, medicaments, vaccines and the like in Brazil. Apart from such products, only exports of small aircraft were recorded during the 1950s. Yet new high technology products came to the fore in the mid-1960s. The most important were office and automatic data processing machines, thermionic, cold and photo-cathode valves, tubes and parts, and rotating electric plants and parts (Table 5). In addition to these products, there were also exports of telecommunications equipment and parts, electrical power machinery and electrical machinery and apparatus.

The technological content of exports therefore reveal a mixed scenario. Brazil's industrial sector was predominantly labour intensive, low skill and technologically simple; but diversification of the exports structure towards more sophisticated products, although slow and limited, indicates a process of gradual technological development and increasing productivity that took place during the post-war years.

### Technology in individual firms and industries

The last type of evidence for our assessment of the performance of ISI in Brazil comes from the history of specific industries and firms. A case in point is the motor vehicle parts sector, whose estimated

number of firms jumped from 30 in 1946 to 1,300 in 1960 (Colistete, 2001, p. 10; Gattás, 1981; Addis, 1993). A strategy favoured by local companies was to establish partnerships with foreign companies to import, assimilate and adapt technologies.[14] Metal Leve, for example, was set up in 1950 and started to produce pistons and piston pins with the technical assistance of the German firm Mahle. Cofap, established in 1951, made agreements in the following years with American (Perfect Circle, Monroe, Thompson) and German (Boge and Mahle) companies to produce piston rings, cylinder parts and dampers. These and other domestic firms adopted a strategy of forging links with foreign companies to enter the marketplace, and then developed their own expertise in engineering, designing, product quality, and distribution. Metal Leve and Cofap sought to recruit a qualified labour force, established links with research centres and provided above-average conditions and welfare. Both companies were able to raise productivity, produce high-quality products and become competitive on both domestic and foreign markets in the following decades ("Cofap", 1958; Mahle, 2000; Doretto, 2006).[15]

Another example was the machine-tools industry. This sector grew out of simple repair and maintenance shops that diversified into machinery production stimulated by import restrictions and increasing domestic demand for capital goods (Leff, 1968; Lago et al., 1979). In 1961, there were approximately 114 establishments employing about 5,000 workers in Brazil, turning out a wide range of products such as lathes, shapers, presses, machines for sheets and drilling machines. Machine tools production grew at annual average rate of 21.1 percent between 1955 and 1961. This was an industry known for its highly demanding standards of skills, mechanical precision and product quality (ECLA, 1969, p. 71-87; Leff, 1968, ch. 3-4).

An illustration of innovative firms producing machine tools is Romi, a former agricultural machinery producer in the 1930s which turned to the production of lathes during the 1940s in the city of Santa Bárbara d'Oeste, state of São Paulo.[16] The company grew rapidly during World War II and later, jumping from 120 employees in 1938 to nearly 1,000 in 1944, 1,726 in 1957 and 4,163 in 1980. Production of lathes increased at a relatively steady pace, as shown in Table 6, column 1.[17]

*Table 6.* Production of lathes by Romi, 1941-1979

| Year | Total output (units) (1) | Domestic output (units) (2) | Exports (units) (3) | Exports share (4)=(3)/(1) |
|---|---|---|---|---|
| 1941 | 46 | 46 | 0 | 0.0 |
| 1942 | 193 | 193 | 0 | 0.0 |
| 1943 | 770 | 770 | 0 | 0.0 |
| 1944 | 899 | 891 | 8 | 0.9 |
| 1945 | 1,098 | 994 | 104 | 9.5 |
| 1946 | 1,660 | 1,145 | 245 | 14.8 |
| 1947 | 1,110 | 610 | 500 | 45.0 |
| 1948 | 731 | 440 | 291 | 39.8 |
| 1949 | 798 | 630 | 168 | 21.1 |
| 1950 | 857 | 857 | 0 | 0.0 |

[14] Other major ways of absorbing foreign technology by Brazilian firms were reverse engineering, licensing and technical assistance: see Leff (1968); Biato and Guimarães (1973); Erber, Guimarães and Araújo Jr. (1974); Braga and Matesco (1989).

[15] A similar strategy was pursued by firms in other branches, such as steel: Dahlman (1984), pp. 317-34; Dahlman and Fonseca (1987), p. 154-82.

[16] Romi and Metal Leve were picked up as noticeable examples of innovative firms in Latin America by a wide-ranging inquiry in the 1980s, as reported by Katz (1984), p. 130-132.

[17] Romi Archives. Santa Bárbara d'Oeste, São Paulo.

| Year | Total output (units) (1) | Domestic output (units) (2) | Exports (units) (3) | Exports share (4)=(3)/(1) |
|---|---|---|---|---|
| 1951 | 1,379 | 1,379 | 0 | 0.0 |
| 1952 | 942 | 938 | 4 | 0.4 |
| 1953 | 880 | 876 | 4 | 0.5 |
| 1954 | 1,306 | 1,306 | 0 | 0.0 |
| 1955 | 1,492 | 1,492 | 0 | 0.0 |
| 1956 | 1,629 | 1,596 | 33 | 2.0 |
| 1957 | 1,449 | 1,446 | 3 | 0.2 |
| 1958 | 1,779 | 1,776 | 3 | 0.2 |
| 1959 | 1,237 | 1,233 | 4 | 0.3 |
| 1960 | 1,659 | 1,646 | 13 | 0.8 |
| 1961 | 1,756 | 1,719 | 37 | 2.1 |
| 1962 | 1,979 | 1,865 | 114 | 5.8 |
| 1963 | 1,679 | 1,367 | 312 | 18.6 |
| 1964 | 1,784 | 1,391 | 393 | 22.0 |
| 1965 | 1,535 | 1,112 | 423 | 27.6 |
| 1966 | 2,011 | 1,569 | 442 | 22.0 |
| 1967 | 1,875 | 1,453 | 422 | 22.5 |
| 1968 | 2,219 | 1,788 | 431 | 19.4 |
| 1969 | 1,905 | 1,357 | 548 | 28.8 |
| 1970 | 1,690 | 1,226 | 464 | 27.5 |
| 1971 | 2,009 | 1,469 | 540 | 26.9 |
| 1972 | 2,346 | 1,778 | 568 | 24.2 |
| 1973 | 2,814 | 2,227 | 587 | 20.9 |
| 1974 | 3,009 | 2,621 | 388 | 12.9 |
| 1975 | 4,317 | 3,599 | 718 | 16.6 |
| 1976 | 4,843 | 4,567 | 276 | 5.7 |
| 1977 | 4,872 | 4,555 | 317 | 6.5 |
| 1978 | 5,762 | 4,867 | 895 | 15.5 |
| 1979 | 6,740 | 4,569 | 2,171 | 32.2 |

*Source*: Romi Archives.

Romi started to export by the end of the World War II, achieving high export shares in total production of lathes in 1947 (45.0 percent) and 1948 (39.8 percent), likely as a result of the disruption of traditional suppliers in international markets by the global conflict. Indeed, lathe exports practically disappeared from Romi's records when international trade was restored in the following years. Only from the early 1960s the company resumed its sales in foreign markets, possibly helped by exchange rate incentives implemented from the end of the 1950s and by accumulated experience in domestic markets. The average share of exports increased from 0.4 percent in the 1950s to 16.9 percent in the 1960s and 18.9 percent in the 1970s (Table 6, columns 3 and 4).

More detailed export data are available for 1962-1967, when Romi exported on average 19.7 percent of its lathe production, totalling 2.106 units (Table 6, columns 3 and 4). Importers were distributed among South and Central America (49.9 percent), North America (33.3 percent), Western Europe (12.4 percent), Africa (1.8 percent), Eastern Europe (1.7 percent), Middle East (1,0 percent), Oceania (0.6 percent) and Asia (0.3 percent). Seventy percent of all foreign sales in the period were

concentrated in five countries: Chile (24.3 percent), Mexico (21.7 percent), the United States (8.6 percent), Netherlands (8.3) and Peru (7.1 percent).[18]

Available data of patenting suggest that Romi actively engaged in incremental innovation. Romi's first patent dates from 1942, and by 1967 there are records of 120 patents registered by the company in Brazil (68.3 percent), Argentina (8.3 percent), Germany (8.3 percent), Great Britain (5.8 percent), Italy (4.2 percent) and the United States (3.3 percent). These patents were for product improvements such as speed control devices, as well as new models of lathes.[19]

As expected, successful firms like Metal Leve, Cofap and Romi do not tell the whole history of the manufacturing industry in post-war Brazil. Qualitative and quantitative evidence indicates that there was a wide range of productivity and efficiency standards within individual industries. Rather than a peculiar feature of the Brazilian manufacturing industry, uneven and unbalanced productivity growth seems to represent a common pattern of industrial growth in general. Sharp differences in sectoral productivity led Arnold Harberger to describe industrial growth as a 'mushroom-like' instead of an even, 'yeast-like' process. William Baumol depicted economic growth as a unbalanced process, combining 'stagnant' and 'progressive' sectors in terms of productivity growth. Nonetheless, specific institutional and social conditions of Brazilian economic history may have accentuated such features (Haberger, 1998; Baumol, 1967; Baumol, Blackman and Wolff, 1985).

The cases of Romi and the capital goods industry illustrate the point. Although Romi was clearly a successful example of innovative company, it was just part of a small group of firms in the emerging capital goods industry in Brazil. A field-work study carried out by ECLA in 1961 found out that only eight out of ninety machine-tools firms surveyed in Brazil achieved international standards of productivity and technological development. True, the leading group employed 55.4 percent of the total employees and owned 63.6 percent of installed capacity in the sample. According to the ECLA study, this group held 'complete, efficient and up-to-date production equipment, and at the same time the technical knowledge required for the proper use of the machines'; its manufacturing processes kept pace 'with the constant technological advances of the sector'. These firms reached 'international standards comparable with those registered in the more highly industrialised countries'. However, the remaining firms used antiquated equipment, lacked technical expertise and turned out low-quality products. Thus, along with the development of high standards, the Brazilian machine-tools industry was also noteworthy by the heterogeneous conditions of its firms in terms of productivity, quality and technological development (ECLA, 1969, p. 73, 78-79).[20] Caren Addis has also shown that, despite the successful cases such as Cofap and Metal Leve, most of the national firms in the parts vehicle industry lagged far behind and concentrated in replacement markets and low-quality production (Addis, 1993).

Strong heterogeneity in productivity and technology was also a feature of traditional industries in post-war Brazil. A detailed study of cotton textile producers in Latin America in the early 1950s by ECLA estimated that 91 percent of the spindles and 95 percent of the looms in Brazil were more than twenty years old. São Paulo state's mills differentiated themselves from those in other states by their higher share of new equipment (about 15 percent) and productivity. Referring to a sample of modern firms in the spinning industry, the ECLA inquiry pointed out that 'good productivity conditions' prevailed in São Paulo and that '[a]ll the mills manufactur[ed] a limited number of yarns and [were] outstanding for the high quality of their management'. Quality control of intermediate and final products was common and 'most of the mills [were] equipped with laboratories and well-trained technicians' (United Nations, 1951, p. 23). For their part, old mills suffered more acutely from equipment obsolescence, poor layout, lack of quality control, defective raw materials, untrained and superfluous labour force.

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[18] Annual Reports, 1962-1967. Romi Archives.

[19] *Ibid*. These percentages likely include double counting, since one invention could be patented in more than one country simultaneously.

[20] High heterogeneity in the capital goods sector was also reported by another survey: Erber, Guimarães and Araújo Jr. (1974), p. 16-7.

Interestingly, the ECLA inquiry also found that not only old firms, but also modern mills operated well below their productivity potential. There was room for significant increases in labour productivity by modern mills – 54 percent in spinning and 98 percent in weaving compared to 280 percent and 694 percent, respectively, in the old sector. In modern spinning mills, neither size nor degree of modernity was the main factor explaining productivity levels. According to the study, the key reason for substandard labour productivity was the use and quality of the labour force. Few machines assigned to tenders, excess of workers in all sections, small work loads, untrained labour force and high turnover were the deficiencies singled out as the major causes of relatively low productivity even in modern textile firms.[21]

The ECLA study interpreted poor quality and defective use of labour force, along with technological obsolescence in the old sector, as a result of the fact that firms' incentives to modernise were weak or absent. Two major reasons were highlighted. First, the pressure to modernise was 'extremely weak, principally owing to the relative unimportance of the average wage level in industry, as compared with the average price of textile goods'. Compared to the price of a popular fabric in local markets ( = 100), the estimated cost per person-hour of work in Brazil was 60, while in the United States it was 355. Secondly, 'the lack of proportion in the measures adopted to protect industry ... [had] also limited any incentive ... to reduce costs and to improve the quality of the products'. Low wage levels and high trade protection,

More than ten years later, another inquiry by ECLA highlighted wage levels and foreign competition as central causes of low productivity levels. The 1963 study found that there was little difference between the efficiency conditions of Brazilian textile industries in the early 1950s and early 1960s – rather, possibly the situation had even deteriorated. Firms failed to replace obsolete machinery at a significant rate and, particularly, to improve quality of raw materials, maintenance, and use of labour. Average productivity levels remained well below international standards. In cotton weaving, for example, Brazilian mills achieved only 10.3 percent of the US productivity levels in 1963 – Japan, for example, reached 38.9 percent. Again, in both cotton spinning and weaving industries, the role of machinery obsolescence and size was small, whereas conditions of the labour force were the most important factor in explaining productivity levels (ECLA, 1963, p. 54; 65, table 87).[22]

The situation in the textile industry described by ECLA seems to have been typical in other branches of manufacturing industry in post-war Brazil. Low average wage levels relative to labour productivity and weak foreign competition helped create an environment which did not favour high manufacturing standards.[23] A relatively small group of firms that supplied more demanding consumers in local markets, as in the case of the leading group of machine tools producers, had the incentives and pressure to modernise. Likewise, competition in domestic markets also created pressure on firms to raise productivity, as in the case of São Paulo cotton spinning firms. These were firms noticeable for their high manufacturing standards and high productivity. Nevertheless, incentives to modernise and increase productivity were not strong enough to reach the firms across the board. There was little pressure from labour markets and foreign competition to scrap obsolete equipment, improve organisational structures and use the labour force and other resources more efficiently, so that even highly inefficient methods of production and firms were able to survive. The outcome was a highly heterogeneous industrial structure in terms of productivity, quality and technology.[24]

Besides the pressures from labour markets and foreign competition, the ability of firms to innovate

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[21] For international comparisons (including Brazil) of productivity in the textile industry which emphasise the conditions of labour, see Clark (1987), p. 141-73.

[22] In ECLA's regression analysis, obsolescence and size explained 14 percent of productivity levels in cotton spinning and 24 percent in cotton weaving (ECLA, 1963, p. 78-9).

[23] Unit labour costs (given by the relation between real wages and labour productivity) in Brazil's manufacturing industry showed a steady decline from 1945 to 1978. See Colistete (2009).

[24] Further evidence on highly heterogeneous levels of productivity and technology in Brazilian manufacturing industry is found in Dahlman and Frischtak (1993); Tyler (1976), p. 868; Erber, Guimarães and Araújo Jr. (1974), p. 16-7; Braga and Matesco (1989), p. 8-11.

was also affected by the social set-up of post-war Brazil, in particular by those factors that influenced conditions, incentives and attitudes of the labour force. Both theoretical and historical works have pointed out that educational levels of the population, industrial training systems, working conditions, and labour relations affect the quality of the labour force, engagement in the production process and innovation in the workplace (e.g., Leibenstein, 1966; Lewchuk, 1987; Lall, 1992). ECLA's observations about small work loads, excess of workers, lack of industrial training and high turnover were a direct reflection of the way that Brazil's social set-up affected the labour force and the production process.

Overall social conditions were not favourable for developing quality production and innovation. For example, statistics on the average years of education for Brazil in 1950 and 1973 show low standards: 2.1 years and 3.8 years, compared to 9.1 years and 10.7 years in Western Europe, 9.1 years and 12.1 years in Japan, and 3.4 years and 6.8 years in Korea, respectively (Maddison, 1995, p. 77, table 3-12). The number of workers who completed some type of apprenticeship or other programme organised by the National Service of Industry (*Serviço Nacional da Indústria* or SENAI) between 1946 and 1960, for instance, never exceeded two percent of the total industrial workforce in the state of São Paulo, by far the main industrial centre in Brazil (Colistete, 2001, p. 40-41).[25] As late as in 1980, 73 percent of the Brazilian labour force had no formal education or had not completed primary school (Dahlman and Frischtak, 1993, p. 439). Innovative firms like Romi and Metal Leve dealt with such deficiencies by establishing close links with SENAI and public research centres, as well as offering efficiency wages, above-average working conditions and social welfare, in order to recruit and maintain qualified and committed workers. But the dominant feature of industrial companies in general was one of low wages, poor conditions and low qualification, providing few incentives for workers to cooperate and engage in incremental innovation on the shopfloor.

Finally, labour relations in post-war Brazil were highly confrontational and antagonistic, both on the shopfloor and in society at large. Employers held an anti-labour policy which rejected compromise with the leftist labour militancy which had taken over official trade unions and helped mobilise at grassroots levels since 1945, demanding real wage increases and social rights. International cold war politics just made more difficult a social compact that could help promoting both rapid economic growth and social reforms. Labour productivity grew more rapidly than real wages so that the gap between industrial wages and profits widened in the post-war years. Thus a confrontational pattern of labour relations added to an environment which was already little favourable to a sustained increase in manufacturing standards (Colistete, 2007).

## Conclusions

Market critics of import-substituting industrialisation in Latin America have long pointed to the accumulated distortions and inefficiencies resulting from exceptionally high protection and import substitution at any cost that prevailed in most countries of the region. An influential view has argued that new industrial countries such as Brazil paid a very high price for their short-term success in economic growth and industrial diversification. Interventionist state policies, in particular high trade protection, led to massive distortions that caused widespread economic inefficiency and a lack of technical progress. Import-substituting industrialisation would then be a failure precisely in that country which until the 1970s had been the most successful late industrialiser in Latin America. A different view was taken by scholars who stressed the heterogeneous outcomes of import-substituting industrialisation, despite also emphasising distortions and inefficiencies. A still sparse body of empirical work on individual industries and firms has gathered evidence about technological learning and productivity in Brazil, suggesting that the legacy of import-substituting industrialisation was one of mixed and uneven results.

The data presented in this article have not confirmed the view of pervasive technological stagnation and low productivity. A number of firms sought to improve products and processes, and were competitive by international standards during the classic period of import-substituting industrialisation in Brazil. This result is still more relevant given the policy of indiscriminate trade barriers and import substitution at any cost that reduced the competitive pressure on firms to produce efficiently and, in

[25] See other comparisons regarding industrial training in Lall (1992) and Dahlman and Frischtak (1993).

addition, gave rise to a high bias against exports in manufacturing industries in the post-war period. Other factors acted as an incentive to setting up new and more technologically advanced industrial plants, such as expanding markets, externalities and learning effects stemming from increasing local production. In the early 1980s the collapse of the debt-led growth strategy which had been pursued from the mid-1960s checked the expansion of local companies. Data on the productivity catch-up with the United States and OECD indicate that Brazilian industrial firms were severely hit by the effects of the economic crisis, in the form of cuts in private and public spending, macroeconomic instability, increasing unemployment, soaring prices and external imbalances.

At the same time, data on labour productivity, manufactured exports and specific firms and industries show that, even before the debt crisis, the drive for technical progress and efficiency was limited and highly heterogeneous in post-war Brazil. Heterogeneity of firm behaviour, uneven productivity increase and unbalanced sectoral growth seem to be common features of industrial growth in general, but sectoral empirical studies have for some time indicated that technological advances and productivity growth were highly unequal in Brazilian industrialisation. There is still a need to further comparative research in order to test these findings, but ECLA's empirical studies in the 1950s and 1960s pointed out that a key reason for the wide range of productivity and technological levels among Brazilian firms was the conditions of labour markets and foreign competition. Firms that supplied to increasingly demanding consumers and that faced higher competition in domestic markets came under pressure to modernise, improve methods of production, and strive for higher productivity. These firms achieved high standards, as shown above by the study cases of motor vehicle parts and machine tools companies. Otherwise, incentives to modernise and increase productivity were weak or absent in most firms, given the low real wages and high trade protection that prevailed in Brazil. Such conditions ensured that even very inefficient firms could survive by using obsolete equipment, turning out low-quality production, achieving low productivity and paying low wages. Besides, firms' ability to raise productivity and quality production was hampered by a low-paid and low-skilled labour force, which overall lacked incentives to cooperate in the shop floor. This was the burden of a social set-up marked by highly unequal income distribution, deficient supply of education and low living standards of the working classes.

From the evidence presented here, it seems that the negative effects of exceptionally high trade barriers stressed by market critics were important, but hardly the only factor that explained the performance of firms and industries. More likely, trade protection joined with labour markets and social conditions to shape the way industrialisation took place in post-war Brazil. The resulting heterogeneous structure became an important feature of import-substituting industrialisation, as only a group of leading firms gained a competitive edge in the manufacturing sector.

Plausible as perhaps this story is, we still need much more detailed, empirically sound historical studies on industrialisation, in particular at the micro-level of firms and industries. This story nonetheless fits better with the available evidence than the stagnationist hypothesis of import-substituting industrialisation in Brazil. Rather than suffering pervasive technological stagnation, several firms sought to modernise and increase productivity. And rather than failure, there were successful cases and mixed results.

## Appendix

**Sources for labour productivity data (tables 2 and 3):**

Labour productivity estimates were obtained by dividing the *valor da transformação industrial* (a measure similar to the industrial value added: see Brazil, 1990, p. 370) by the monthly average number of production workers. The *valor da transformação industrial* was deflated by a wholesale price index, the *Índice de Preços ao Atacado* (IPA), calculated by *Fundação Getúlio Vargas*.

*Data on wages/number of production workers and valor da transformação industrial:*:

1945-1948: wages and production workers extrapolated from the level of average manufacturing wages and number of workers in 1949 (*Censo Industrial*, 1950) by using the rates of growth of the industrial wages and workers compiled by the *Instituto de Aposentadoria e Pensões dos Industriários* (IAPI). *Valor da transformação industrial* was obtained by interpolating data provided by the industrial census: *Censo Industrial*, 1940 (base year: 1939) and 1950 (base year: 1949) (Brazil, 1990).

1949 e 1959: Brazil, *Censo Industrial*, 1950 e 1960, manufacturing industry (Brazil, 1990).

1952-1958, 1962: Brazil, *Registro Industrial*, manufacturing industry (Brazil, *Anuários Estatísticos do Brasil*, 1955, 1956, 1957, 1958, 1959, 1960 and 1965).

1963-1969: Brazil, *Pesquisa Industrial*, manufacturing industry (Brazil, *Anuários Estatísticos do Brasil*, 1966, 1967, 1970 and 1971).

1970, 1972-1978: Brazil, *Pesquisa Industrial Anual*, manufacturing industry (Brazil, 1990).

1950, 1951, 1960, 1961, 1971: estimated by linear interpolation.

*Deflators:*

Sectoral wholesale prices, the *Índices de Preços ao Atacado* (IPA), published by Conjuntura Econômica, Fundação Getúlio Vargas, were used as deflators:

1945-1969: *Conjuntura Econômica*, September 1969; October 1969; July 1971, economic indicators section: seven wholesale prices (metals, leather and footwear, textiles, chemical products, beverages, food products, manufactured products) used to deflate the industrial value added (ie, the *valor da transformação industrial*) of roughly similar industries.

1970-1979: *Conjuntura Econômica*, May 1979; April 1981, economic indicators section: seventeen individual wholesale prices (*IPA-Oferta Global*) matching the industrial groups of table 2. These two series were chained and coverted to reference year 1952. Details of the procedures and the basic series can be obtained with the author.

## Bibliography


*A História da Indústria de Autopeças no Brasil*. São Paulo: Mahle, 2000.

Abreu, Marcelo, Ed. *A Ordem do Progresso. Cem Anos de Política Econômica Republicana, 1889-1989*. Rio de Janeiro: Campus, 1990.

Addis, Caren. *Local Models: Auto Parts Firms and Industrialization in Brazil*. PhD Thesis, MIT, 1993.

Ashton, David, and Green, Francis. *Education, Training and the Global Economy*. Cheltenham: Edward Elgar, 1996.

Astorga, Pablo; Bergés, Ames, and Fitzgerald, Valpy. "Productivity Growth in Latin America during the Twentieth Century". *Oxford University Discussion Papers in Economic and Social History*. 52, Dec., 2003.

Baer, Werner. *Siderurgia e Desenvolvimento Brasileiro*. Rio de Janeiro: Zahar, 1970.

Baer, Werner. "Import Substitution and Industrialization in Latin America: Experiences and Interpretations." *Latin American Research Review* 7 (1972): 95-122.

Baer, Werner. *Brazilian Economy: Growth and Development*. 5th ed., Westport: Greenwood, 2001.

Baer, Werner, Manuel Fonseca, and Joaquim Guilhoto. "Structural Changes in Brazil's Industrial Economy." *World Development* 15 (1987): 275-86.

Balassa, Bela. "Growth Strategies in Semi-Industrial Countries." *Quarterly Journal of Economics* 84 (1970): 24-47.

Balassa, Bela. "Nominal and Effective Protection in Seven Countries." In *The Structure of Protection in Developing Countries*, edited by Bela Balassa and Associates, 49-69. Baltimore: Johns Hopkins Press, 1971.

Balassa, Bela. "Evaluation of the System of Protection." In *The Structure of Protection in Developing Countries*, edited by Bela Balassa and Associates, 71-88. Baltimore: Johns Hopkins Press, 1971.

Balassa, Bela. "Incentive Policies in Brazil." *World Development* 7 (1979): 1023-49.

Balassa, Bela. *Development Strategies in Semi-Industrial Economies*. Baltimore: John Hopkins University Press, 1982.

Baumol, William. "Macroeconomics of Unbalanced Growth: the Anatomy of Urban Crisis." *American Economic Review* 57 (1967): 415-426.

Baumol, William; Sue B. Blackman, and Edward Wolff. "Unbalanced Growth Revisited: Asymptotic Stagnancy and New Evidence." *American Economic Review* 75 (1985): 806-817.

Bergsman, Joel, and Pedro Malan. "The Structure of Protection in Brazil." In *The Structure of Protection in Developing Countries*, edited by Bela Balassa and Associates, 103-36. Baltimore: Johns Hopkins Press, 1971.

Bhagwati, Jagdish. *Anatomy and Consequences of Exchange Control Regimes*. Cambridge: NBER, 1978.

Biato, Francisco, and Eduardo Guimarães. "Dois Estudos sobre Tecnologia Industrial no Brasil." *Pesquisa e Planejamento Econômico* 3 (1973): 135-82.

Braga, Helson, and Virene Matesco. "Desempenho Tecnológico na Indústria Brasileira: uma Análise Exploratória." *Textos para Discussão*, IPEA, 1989.

Braga, Helson, and William Tyler. "Trade Policies in Brazil." *Textos para Discussão*, IPEA, 1990.

Brazil. Instituto Brasileiro de Geografia e Estatística (IBGE). *Anuário Estatístico do Brasil*. Rio de Janeiro: IBGE, various years.

Brazil. Instituto Brasileiro de Geografia e Estatística (IBGE). *Censo Industrial de 1950: Brasil*. Rio de Janeiro: IBGE, 1967.

Brazil. Instituto Brasileiro de Geografia e Estatística (IBGE). *Censo Industrial de 1960: Brasil*. Rio de Janeiro: IBGE, 1967.

Brazil. Instituto Brasileiro de Geografia e Estatística (IBGE). *Estatísticas Históricas do Brasil*. 2nd ed., Rio de Janeiro: IBGE, 1990.

Bulmer-Thomas, Victor. *The Economic History of Latin America since Independence*. Cambridge: Cambridge University Press, 1994.

Cárdenas, Enrique, José Antonio Ocampo, and Rosemary Thorp. "Introduction." *An Economic History of Twentieth-Century Latin America*, edited by Enrique Cárdenas, José Antonio Ocampo, and Rosemary Thorp, 1-35. Houndmills: Palgrave Macmillan, 2001.

Clark, Gregory. "Why Isn't the Whole World Developed? Lessons from the Cotton Mills." *Journal of Economic History* 47 (1987): 141-73.

Clark, Gregory. *A Farewell to Alms: a Brief Economic History of the World*. Princeton: Princeton University Press, 2007.

"Cofap, Grande Indústria de Camisas, Anéis de Pistão e Amortecedores." *Revista da Indústria Automobilística* 1 (1958): 21-9.

Colistete, Renato P. *Labour Relations and Industrial Performance in Brazil, 1945-1960*. Houndmills: Palgrave Macmillan, 2001.

Colistete, Renato P. "Productivity, Wages, and Labor Politics in Brazil, 1945-1962." *Journal of Economic History*. 67 (2007): 93-127.

Colistete, Renato P. "Salários, Produtividade e Lucros na Indústria Brasileira, 1945-1978." *Revista de Economia Política*, vol. 29, no. 4 (2009): 386-405.

Dahlman, Carl. "Foreign Technology and Indigenous Technological Capability in Brazil." In *Technological Capability in the Third World*, edited by Martin Fransman and Kenneth King, 317-34. New York: St. Martin's Press, 1984.

Dahlman, Carl, and Francisco Sercovich. "Exports of Technology from Semi-Industrial Economies and Local Technological Development." *Journal of Development Economics* 16 (1984): 63-99.

Dahlman, Carl, and Fernando Fonseca. "From Technological Dependence to Technological Development: the Case of the Usiminas Steelplant in Brazil." In *Technology Generation in Latin American Manufacturing Industries*, edited by Jorge Katz, 154-82. New York: St. Martin's Press, 1987.

Dahlman, Carl, and Claudio Frischtak. "National Systems Supporting Technical Advance in Industry: the Brazilian Experience." In *National Innovation Systems. A Comparative Analysis*, edited by Richard Nelson, 414-50. Oxford: Oxford University Press, 1993.

Dalum, Bent. "Export Specialisation, Structural Competitiveness and National Systems of Production." In *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*, edited by Bengt-Åke Lundvall, 191-225. London: Pinter, 1992.

Dean, Warren. *The Industrialization of São Paulo, 1880-1945*. Austin: University of Texas Press, 1969.

Doretto, Maria Lucia. *Kasinsky: Um Gênio Movido a Paixão. A História do Fundador da Cofap*. São Paulo: Ediouro, 2006.

Dosi, Giovanni, Keith Pavitt, and Luc Soete. *The Economics of Technical Change and International Trade*. New York: New York University Press, 1990.

ECLA. *The Textile Industry in Latin America. II – Brazil*. New York: United Nations, 1963.

ECLA. "The Manufacture of Machine Tools in Brazil." In *Development of Metalworking Industries in*

*Developing Countries*, 71-87. New York: United Nations, 1969.

Edwards, Sebastian; Esquivel, Gerardo and Márquez, Graciela. "Introduction." In *The Decline of Latin American Economies. Growth, Institutions and Crisis*, edited by Sebastian Edwards, Gerardo Esquivel and Graciela Márquez, 15-57. Chicago: University of Chicago Press, 2007.

Elías, Victor. *Sources of Growth: A Study of Seven Latin American Countries*. San Francisco: ICS Press, 1990.

Erber, Fabio, Eduardo Guimarães, and José Tavares Araújo Jr. *Absorção e Criação de Tecnologia na Indústria de Bens de Capital*. Rio de Janeiro: FINEP, 1974.

Fabricant, Solomon. *Employment in Manufacturing, 1899-1939: an Analysis of Its Relation to the Volume of Production*. New York: NBER, 1942.

Fagerberg, Jan. "Technological Progress, Structural Change and Productivity Growth: a Comparative Study." *Structural Change and Economic Dynamics* 11 (2000): 393-411.

Fajnzylber, Pablo, and Daniel Lederman. "Economic Reforms and Total Factor Productivity Growth in Latin America and the Caribbean, 1950–95: An Empirical Note'. *World Bank Working Paper*, number 2114, 2000.

Ferreira, Pedro Cavalcanti; Samuel Pessôa and Fernando Veloso, 'The Evolution of TFP in Latin America: High Productivity when Distortions Were High?', manuscript, 2009

Fishlow, Albert. "Brazilian Development in Long-Term Perspective." *American Economic Review* 70 (1980): 102-8.

Fishlow, Albert. "A Economia Política do Ajustamento Brasileiro aos Choques do Petróleo: uma Nota sobre o Período 1974/84". *Pesquisa e Planejamento Econômico*. 16 (1986): 507-550.

Fonseca, Pedro Dutra. "Sobre a Intencionalidade da Política Econômica Industrializante do Brasil na Década de 1930." *Revista de Economia Política* 23 (2003): 133-48.

Gattás, Ramiz. *A Indústria Automobilística e a 2a Revolução Industrial no Brasil*. São Paulo: Prelo, 1981.

Haber, Stephen. "The Political Economy of Industrialization." In *The Cambridge Economic History of Latin America*, vol. 2, edited by Victor Bulmer-Thomas, John H. Coatsworth, Roberto Cortés Conde, 537-84. Cambridge: Cambridge University Press, 2006.

Haberger, Arnold. "A Vision of the Growth Process." *American Economic Review* 88 (1998): 1-32.

Haggard, Stephan. *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries*. Cornell: Cornell University Press, 1990.

Hilton, Stanley. "Vargas and Brazilian Economic Development, 1930-1945. A Reappraisal of His Attitude Toward Industrialization and Planning." *Journal of Economic History* 35 (1975): 754-78.

Hirschman, Albert. "The Political Economy of Import-Substituting Industrialization in Latin America." *Quarterly Journal of Economics* 82 (1968): 1-32.

Hofman, André. *The Economic Development of Latin America in the Twentieth Century*. Cheltenham: Edward Elgar, 2000.

Katz, Jorge. "Technological Innovation, Industrial Organisation and Comparative Advantages of Latin America Metalworking Industries." In *Technological Capability in the Third World*, edited by Martin Fransman and Kenneth King, 113-36. New York: St. Martin's Press, 1984.

Krueger, Anne. *Liberalization Attempts and Consequences*. Cambridge: NBER, 1978.

Krueger, Anne. "Trade Policy and Economic Development: How We Learn." *American Economic Review* 87 (1997): 1-22.

Krugman, Paul. "Technical Change in International Trade." In *Handbook of the Economics of Innovation and Technological Change*, edited by Paul Stoneman. Oxford: Blackwell, 1995.

Lago, Luis Aranha C., Fernando Almeida, and Beatriz Lima. *A Indústria Brasileira de Bens de Capital: Origens, Situação Recente e Perspectivas*. Rio de Janeiro: IPEA/INPES, 1979.

Lall, Sanjaya. "Exports of Technology by Newly-Industrializing Countries: An Overview." *World Development* 12 (1984): 471-80.

Lall, Sanjaya. "Technological Capabilities and Industrialization." *World Development* 20 (1992): 165-86.

Lall, Sanjaya. "The Technological Structure and Performance of Developing Country Manufactured Exports, 1985-1998." *Oxford Development Studies* 28 (2000): 337-69.

Lazonick, William. *Competitive Advantage on the Shop Floor*. Cambridge: Harvard University Press, 1990.

Leff, Nathaniel. *Brazilian Capital Goods Industry*. Cambridge: Harvard University Press, 1968.

Leibenstein, Harvey. "Allocative Efficiency vs. 'X-Efficiency'." *American Economic Review* 56 (1966): 392-415.

Lessa, Carlos. *Quinze Anos de Política Econômica*. 2nd ed., São Paulo: Brasiliense, 1982.

Lewchuk, Wayne. *American Technology and the British Vehicle Industry*. Cambridge: Cambridge University Press, 1987.

Little, Ian, Tibor Scitovsky and Maurice Scott. *Industry and Trade in Some Developing Countries: a Comparative Study*. Oxford: Oxford University Press, 1970.

Loayza, Norman, Pablo Fajnzylber and César Calderón. *Economic Growth in Latin America and the Caribbean: Stylized Facts, Explanations, and Forecasts*. Washington: World Bank, 2005.

Macario, Santiago. "Protectionism and Industrialization in Latin America." *Economic Bulletin for Latin America* 9 (1964): 61-101.

Maddison, Angus. *The Political Economy of Poverty, Equity, and Growth. Brazil and Mexico*. Oxford: Oxford University Press, 1992.

Maddison, Angus. *Monitoring the World Economy, 1820-1992*. Paris: OCDE, 1995.

Malan, Pedro, Régis Bonelli, Marcelo P. Abreu, and José E. Pereira. *Política Econômica Externa e Industrialização no Brasil, 1939-52*. 2nd ed., Rio de Janeiro: IPEA, 1980.

Montobbio, Fabio. "Sectoral Patterns of Technological Activity and Export Market Share Dynamics." *Cambridge Journal of Economics* 27 (2003): 523-45.

Peneder, Michael. "Industrial Structure and Aggregate Growth." *Structural Change and Economic Dynamics* 14 (2003): 427-48.

Prados de la Escosura, Leandro. "When Did Latin America Fell Behind?". In *The Decline of Latin American Economies. Growth, Institutions and Crisis*, edited by Sebastian Edwards, Gerardo Esquivel and Graciela Márquez, 15-57. Chicago: University of Chicago Press, 2007.

Prebisch, Raul. *Towards a Dynamic Development Policy for Latin America*. New York: United Nations, 1963.

Romi Archives. Santa Bárbara d'Oeste, São Paulo.

Rosenberg, Nathan. *Perspectives on Technology*. Cambridge: Cambridge University Press, 1976.

Salter, W.E.G. *Productivity and Technical Change*. Cambridge: Cambridge University Press, 1960.

Sercovich, Francisco. "Brazil." *World Development* 12 (1984): 575-99.

Shapiro, Helen. *Engines of Growth. The State and Transnational Auto Companies in Brazil*. Cambridge: Cambridge University Press, 1994.

Srinivasan, T. N., and Jagdish Bhagwati. "Outward-Orientation and Development: Are Revisionists Right?" *Discussion Papers*, Yale Economic Growth Center, 1989.

Stein, Stanley. *Brazilian Cotton Manufacture: Textile Enterprise in an Underdeveloped Area*. Cambridge: Harvard University Press, 1957.

Syrquin, Moshe. "Patterns of Structural Change." In *Handbook of Development Economics*. Vol. 1, edited by Hollis Chenery and T. N. Srinivasan, 203-73. Amsterdam: North Holland, 1988.

Tavares, Maria da Conceição. "Auge e Declínio do Processo de Substituição de Importações no Brasil." In *Da Substituição de Importações ao Capitalismo Financeiro*. Rio de Janeiro: Zahar, 1972.

Teitel, Simon, and Francisco Sercovich. "Latin America." *World Development* 12 (1984): 645-60.

Teitel, Simon, and Francisco Thoumi. "From Import Substitution to Exports: the Manufacturing Exports Experience of Argentina and Brazil." *Economic Development and Cultural Change*. 34 (1986): 455-90.

Thorp, Rosemary. *Progress, Poverty and Exclusion. An Economic History of Latin America in the 20th century*. Baltimore, Inter-American Development Bank, 1998.

Timmer, Marcel, and Adam Szirmai. "Productivity Growth in Asia Manufacturing: the Structural Bonus Hypothesis Examined." *Structural Change and Economic Dynamics* 11 (2000): 371-92.

Tyler, William. "Brazil Industrialization and Industrial Policies: a Review." *World Development* 4 (1976):

863-82.

UNCTAD. *Trade and Development Report 2002*. Geneva: United Nations, 2002.

United Nations, *Labour Productivity of the Cotton Textile Industry in Five Latin American Countries*. New York: United Nations, 1951.

van Ark, Bart. *International Comparisons of Output and Productivity. Manufacturing Productivity of Ten Countries from 1950 to 1990*. Gröningen: University of Gröningen, 1993.

van Ark, Bart, and Marcel Timmer. "The ICOP Manufacturing Database: International Comparisons of Productivity Levels." *International Productivity Monitor* 3 (2001): 44-51.

Wade, Robert. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. 2nd ed., Princeton: Princeton University Press, 2004.

Wells, John. *Growth and Fluctuations in the Brazilian Manufacturing Sector During the 1960s and Early 1970s*. PhD thesis, Cambridge University, 1977.