Chapter 4. Structural change and dynamics of convergence

A very preliminary draft, please do not quote

4.1. Introduction

Since the 1950s, in the field of economics and economic history research focused on structural change and dynamics of convergence has been developed. From a structuralist approach, Prebisch and other scholars from ECLAC have emphasized the decisive role of structural change in order to explain the relative performance of the Latin American economies. The approach had important policy implications. Those economies unable to reallocate the labour force from traditional to dynamic sectors, were deemed to remain underdeveloped and stuck to structural heterogeneity.

More recent works have also contributed to the debate over why some regions could develop and others lagged behind, through explaining structural change for the whole economy or within manufacturing sector.

Between 1930s and 1980s industrial policies played a key role to explain manufacturing´s performance and the dynamics of convergence. In the actual context, a renewed industrial policy debate has revisited this period in order to analyse more deeply the links between policies and performance, as well as learning lessons for the present. However, studies of productivity levels and growth rates disaggregated by industries in Latin American countries are scarce, especially in the interwar period. Most of the evidence for Latin America starts after the 1960s. Therefore, in this chapter I pretend to provide more insight into the debate on structural change and convergence focused on the manufacturing industry and in a comparative perspective

The aim of this chapter is threefold. First, it intends to explore the patterns of productivity growth in the manufacturing sector in three Latin American countries and in the United States and Sweden during the period circa 1930-1980. Second, if their manufacturing sector could carry out structural change measured using a shift-share analysis. Finally, this chapter analyzes the existence of convergence in productivity levels between branches of Brazil, Chile and Uruguay, compared to the United States and Sweden.

In order to carry out the first two exercises it is necessary to collect time series of labour productivity at constant prices, time series of labour, and value added at current prices for several benchmarks. For Brazil and Sweden this data come from other authors' works (Colistete 2007, and Schön 1988; respectively). For Uruguay and the United States, the series are taken from previous own works (Lara 2012, Lara and Hernández 2019, Lara and Prado 2019). For Chile the long series of value added at constant prices and labour were elaborated for the first time in this thesis.

The third exercise requires one or several benchmarks of comparative levels of labour productivity in manufacturing and their industries in relation to a reference country. The benchmarks are moved backwards and forwards using the time series of labour productivity. In Chapter 3 I presented the available benchmarks as well as the new estimates carried out in this thesis.

The evidence for Latin America in the 20th century shows two facts: premature industrialization[1] and a lack of long-run convergence with developed countries (Palma 2005, Rodrik 2016, Castillo and Martins 2017). In this context, it is important to explore the convergence dynamics of the economy and the manufacturing sector during the period in which Latin American countries did industrialize. It is also of interest to know whether there were differences between industries, and to know more about the relationship between structural change, on the one hand, and structural heterogeneity and inequality, on the other.

The main hypothesis is that despite the high level of heterogeneity, at industry level some (few) industries could catch up with the world frontier in terms of labour productivity whereas most industries lagged behind. In turn, it is expected to find uneven patterns of productivity growth over time and absence of structural change. However, in particular subperiods it would be likely to find changes, although moderate, which should be analyzed considering the role of the State and other institutions.

The chapter is divided into three sections after this introduction. Section 4.2 presents the distribution of productivity growth across industries in order to analyze if productivity increases are concentrated in a few industries or are widespread covering the whole manufacturing using Harberger diagrams. Section 4.3. focuses on the impact of specialization and structural changes on productivity growth in manufacturing using a shift share analysis. In section 4.4. an econometric exercise based on unit root tests helps us to analyze the existence of convergence at aggregate and disaggregate level. Industrial trajectories are measured using the labour productivity of Brazil, Chile and Uruguay compared to the labour productivity of the reference countries (the United States and Sweden) for the whole manufacturing and different branches. Section 4.5. concludes.

[1] The concept of premature deindustrialization means that developing countries are moving to service economies before having experienced a proper industrialization period (Rodrik 2016, Dasgupta and Singh 2006).

4.2. Patterns of productivity growth

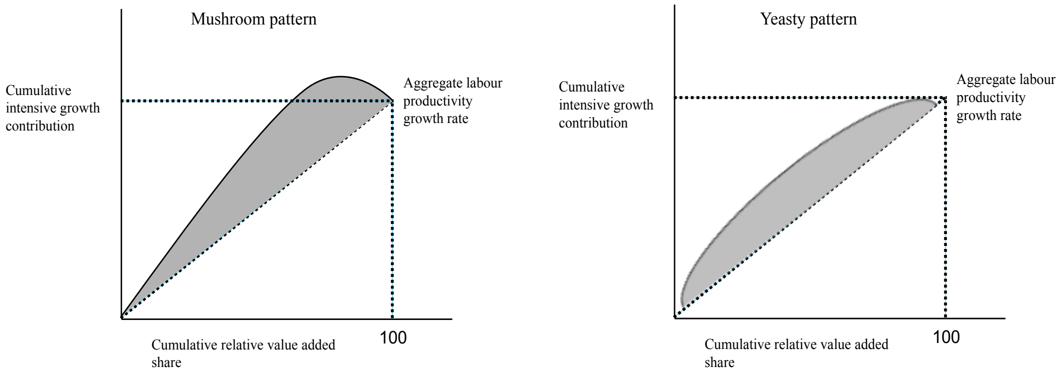
This subsection aims to analyze the concentration of productivity gains across industries in Brazil, Chile, Uruguay, United States and Sweden between 1930 and 1980. The distribution of productivity growth across industries follows the typology "mushrooms and yeast", an approach proposed by Harberger (1998) whose main purpose is to explore if productivity increases are concentrated in a few industries or are widespread covering all the productive structure. This approach was followed by several works for different periods and countries (Inklaar and Timmer 2007, Prado 2014, Bakker et al 2015, Lavopa 2015).

The expression of "mushroom and yeast" refers to the patterns of industry contribution to aggregate productivity growth: a mushroom distribution implies that few industries contribute more to the aggregate productivity growth while a yeast distribution means that industries contribute evenly to total productivity growth. Although the original idea of Harberger was to calculate total factor productivity growth as a result of weighthing growth of labour productivity and growth of capital productivity, in this work it has not been possible due to capital data constraints. Therefore, aggregate productivity growth refers to labour productivity growth, as a good proxy to the Harberger´s notion[2]. Furthermore, this analysis could be applied to a broad range of industries, including services and primary activities. This work focuses exclusively on manufacturing industries.

The Harberger curves are Lorenz-type diagrams which show the cumulative contribution of industries to total labour productivity growth against the cumulative share of these industries in total value added. The area between the line of "perfect equality" (the straight line) and the curves measures the degree of concentration of productivity gains within each economy. This area is the result of variations in the size of the industry and the productivity growth rate. The larger this area, the more mushroom-like is the pattern of productivity growth. Moreover, at a more disaggregated industry level, the group of industries comes closer to the performance of the manufacturing at large, thus it will be more likely to identify yeast-like growth patterns.

[2] Lavopa (2015) and Prado (2014) also employ labour productivity growth as a proxy of TFP. Furthermore, Stiroh supports the idea that labour productivity, instead of total factor productivity, is the more adequate measure of efficiency gains. Technological progress would be contained in the stock of capital (Stiroh 2002).

Figures 4.1. Examples of Harberger diagrams.



Tables 4.1 to 4.5 in the Appendix are the base for the Harberger's diagram. They show the concentration of labour productivity growth among industries by countries, for the total period 1930-1980 and different subperiods. Value added disaggregated by industries at current prices is employed to calculate cumulative share of industries in total value added. This data defines the subperiods by countries over time; and it comes from manufacturing censuses in Brazil and US, censuses and industrial surveys in Chile, censuses and other official statistics in Uruguay. In the case of Sweden, this data was taken from Schön (1988).

The first column presents the labour productivity growth rate in descending order, column 2 shows the initial value added at the beginning year of the subperiod and column 3 the cumulative relative share of initial value added. Column 4 presents the real cost reductions, following Harberger it means the increase in output would have been between the initial and ending year if the industry had operated with the same quantity of inputs as in the initial year. Column 5 has the figures of cumulative intensive growth contribution, it means the percentage shares of the cumulative sums of real cost reductions. Finally, column 6 contains total productivity growth measured as the cumulative weighted productivity growth rate (initial value added as weights).

Figures 4.2 to 4.6 plot the cumulative contribution of industries to total labour productivity growth against the cumulative share of these industries in total value added, and also includes the average growth rate of labour productivity in a secondary vertical axis. Figures 4.2 shows the results for Brazil in the total period and for each of the subperiods, figure 4.3 illustrate the same for Chile, figures 4.4 for Uruguay, figures 4.5 for Sweden and figures 4.6 for the United States.

The choice of subperiods as well as the starting and ending points are relevant in two senses. First, the longer the time period the less chance to capture a mushroom pattern. In this case, the range of subperiods goes from 5 to 10 years (with some exception), as it is usual in the literature. And second, the business cycle on productivity could affect the results in short time periods. Although this point is not especially treated in these estimates, it was considered for some subperiods.

Following previous works, the Harberger coefficient is the area between the curve and the diagonal divided by the total area under the curve. Therefore, it measures the degree of concentration of industry contributions to total labour productivity growth. This ranges goes from 0 to 1, and a lower value indicates higher equality among industrial contributions to labour productivity growth.

First, table 4.1. shows a stable trend in labour productivity growth in the United States over the period. Conversely, a strong acceleration occured in the 1950s and 1970s in Brazil, and in the 1960s in Sweden. Both countries, Brazil and Sweden, recorded the highest productivity rates in the period. On the other side, labour productivity growth in Uruguay was significantly low between 1936 and 1968 and increased at the end of the period (1968-78). While in Chile, this rate oscillated during the period though never surpassed a moderate growth of 3 per cent per annum.

Following the Harberger coefficient, the industry pattern in Brazil was always yeasty and in particular in the 1950s and 1970s. A similar pattern can be appreciated in the United States, with decreasing and low coefficients between 1930s-70s. On the other hand, Chile and Uruguay recorded the highest level of concentration in the 1970s and 1960s, respectively. Notwithstanding, the 1970s in Chile summarizes two different subperiods: 1970-1973 with a yeasty process and 1974-1979 with a stronger mushroom process. In Sweden, the higher concentration in the 1940s was explained by the subperiod 1939-45; and after the WWII it moved towards a more widespread industry pattern until the 1970s.

In few words, Brazil, Sweden and United States performed a yeasty industry pattern, while in Chile and Uruguay yeasty and mushroom growth process occured over the period. In addition, observing the results for every country and every subperiod when labour productivity growth rates increases, the industry pattern becomes more balanced and on the contrary, when labour productivity growth rate decreases, the process is more concentrated in less industries (with the exception of US in the last subperiod). In other words, the brakes to productivity increases go hand in hand with more concentrated industry patterns.

This result should be related to the role of the technology adopted during the period and the impact on the pattern of growth. A yeasty pattern should be more linked to a technology with a great number of spill-over effects. Besides, the introduction of technology in the production process depends on the establishment size, the cost of technology, abundance of natural resources (as sources of energy), technological maturity, among others. Despite exceptions for subperiods and countries, literature for Latin America has argued that external dependence on imported technology and a national bourgeois uninterested to promote innovation contribute to explain limits to the industrialization process (Fajnzylber, 1983).

For Uruguay, Travieso (2015) demonstrated that during the proper industrialization period 1943-1954 there was a greater participation of industries intensive in modern energy (petroleum and electricity) such as non-metallic minerals, petroleum, transport equipment, metals, chemicals, rubber and paper. This result goes hand in hand with a more balanced growth pattern. However, residential consumption and the transport sector consumed more modern energy than manufacturing and after the 1950s it was even deeper. The inability to introduce more modern capital was compatible with a limited interest to an energy transition after the 1950s, which was also encouraged by an absent energy policy. This is reflected in a more concentrated growth process for the years 1955-1968 (Table 4.1.).

Table 4.1. Labour productivity growth rate and Harberger coefficient, by countries, for different subperiods

Labour productivity growth rate	ca 1940s	ca 1950s	ca 1960s	ca 1970s	ca 1980s
Brazil		4.30	3.43	7.25	1.64
Chile	3.14	1.04	3.18	0.09	3.37
Uruguay	0.98		0.88	2.12	
Sweden	0.27	2.12	6.53	2.15	
United States	2.25	2.84	3.81	3.28	3.44
Harberger coefficient	**ca 1940s**	**ca 1950s**	**ca 1960s**	**ca 1970s**	**ca 1980s**
Brazil		0.18	0.23	0.15	0.19
Chile	0.25	0.36	0.20	0.69	0.22
Uruguay	0.35		0.53	0.38	
Sweden	0.48	0.33	0.11	0.15	
United States	0.24	0.12	0.07	0.08	0.29

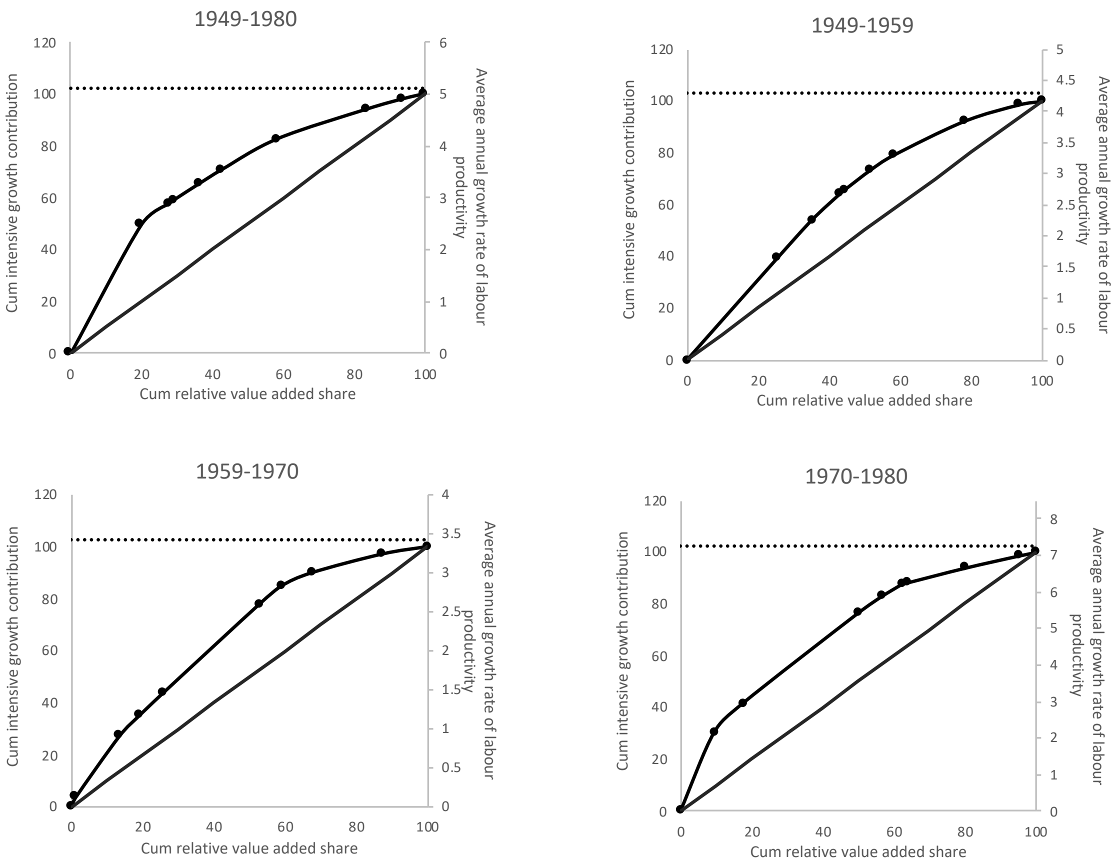
Source:

Lavopa (2015) calculated the Harberger´s diagrams for a more recent period (1973-2007), covering countries such as Brazil, Chile and Sweden among others. He concluded that those economies for developed and developing regions which could successfully change their productive structure, at the same time recorded lower levels of concentration of labour productivity growth. In other words, a yeasty pattern of growth goes in line with a process of structural modernization. In Lavopa´s work the relatively low coefficients in Brazil were closer to a yeasty pattern (0.33 in 1972-82 and 0.35 in 1982-2007); these results remained even lower in the earlier period 1945-1970s. Conversely, while in Chile the coefficients were much higher during his period (0.44 in 1972-82 and 0.95 in 1982-2007) reflecting an increasing mushroom process after 1982, in Sweden it moved from an even (0.29 in 1972-82) to a more unbalanced process (0.51 in 1982-2007).

Concerning the Nordic country, the evidence suggests a dominant mushroom pattern of growth before our period of analysis (Prado, 2014). This result was also found for other developed countries. Prado (2014) concluded that the use of steam in Sweden played a crucial role to explain the more mushroom-like patterns than of yeast during 1869-1901. After that, steam was replaced by electricity and this change was reflected in a more balanced growth in the subperiod 1901-9. The argument is that the use of electricity caused positive externalities and encouraged the skill-intensive industries.

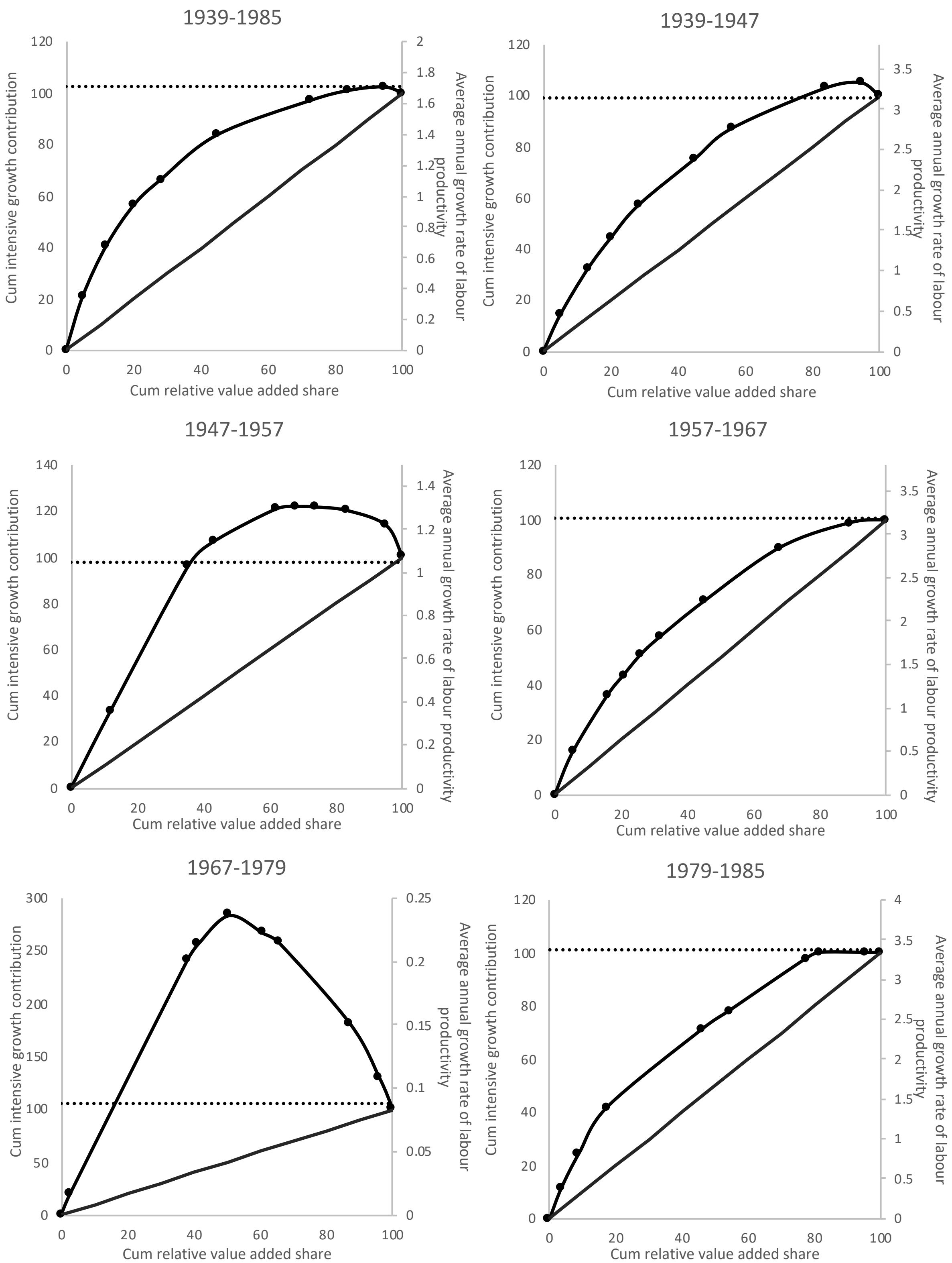
Finally, the American results cannot be directly compared with previous works. Harberger (1998), Inklaar and Timmer (2007) and Bakker et al (2015) presented estimates of total factor productivity growth for the US, covering different time periods and based on groups of industries (and not only manufacturing). The Harberger´s results for 1958-1967 and 1970-1990 (five-year averages), and Inklaar and Timmer for the years 1987-1995 and 1995-2003, concluded that the American TFP growth was characterized by a mushroom pattern. Conversely, Bakker et al (2015) studied the period 1899-1941 using new evidence for human capital, and they found that TFP growth in manufacturing followed a yeasty pattern, excepting for 1909-19.

Figures 4.2. Cumulative distribution of intensive growth contribution by industries. Brazil.



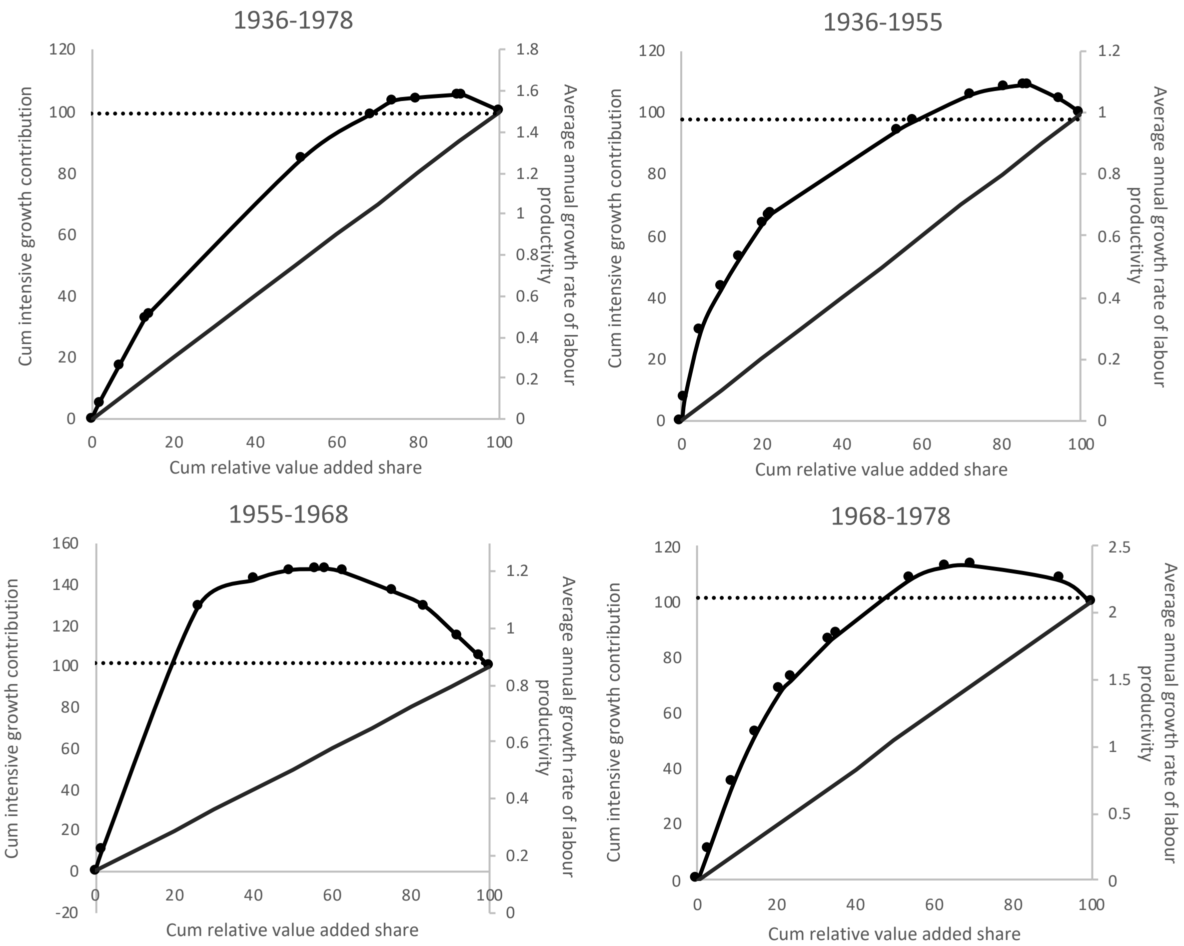
Source: See table 4.1

Figures 4.3. Cumulative distribution of intensive growth contribution by industries. Chile.



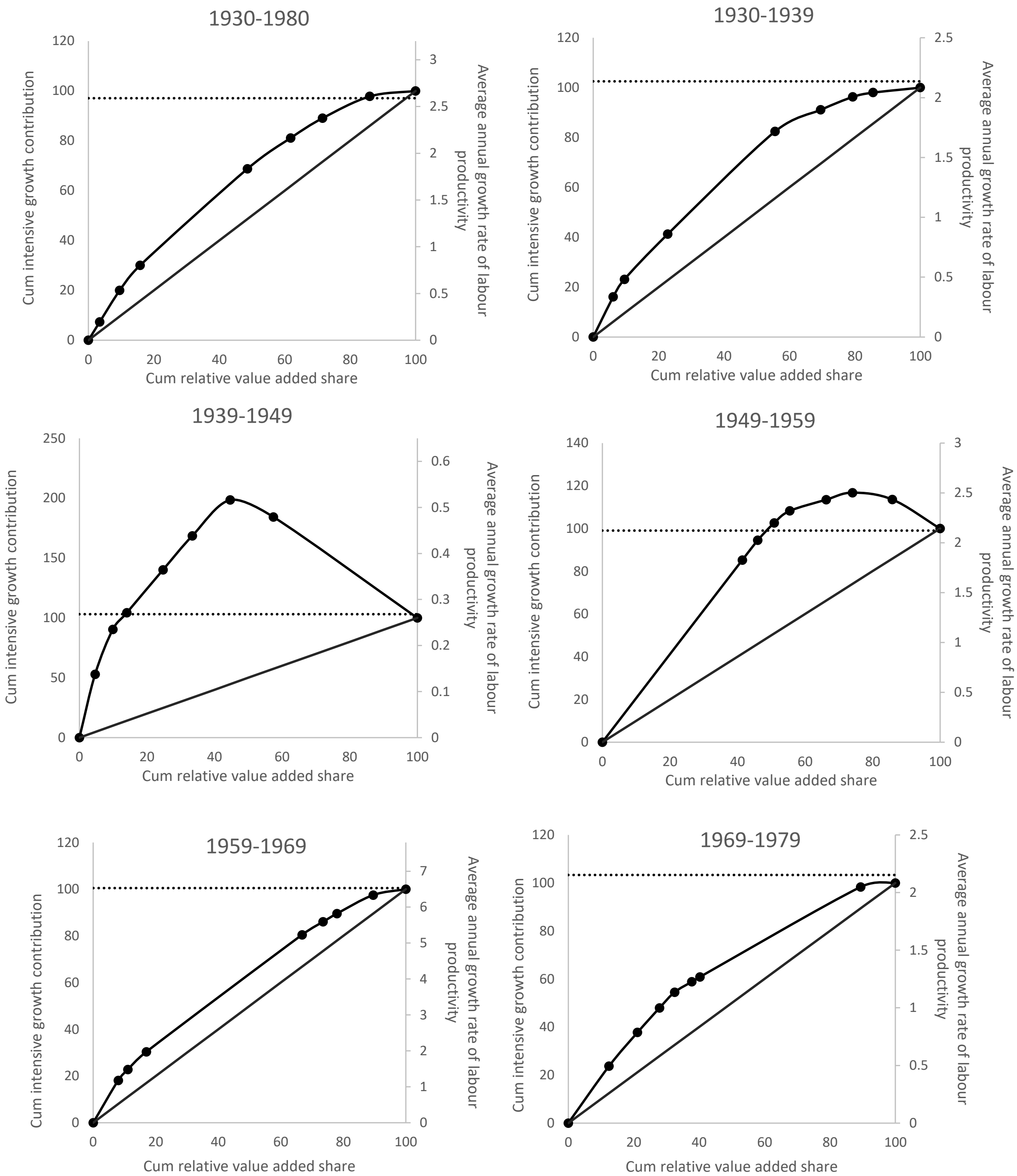
Source: See table XX.

Figures 4.4. Cumulative distribution of intensive growth contribution by industries. Uruguay.



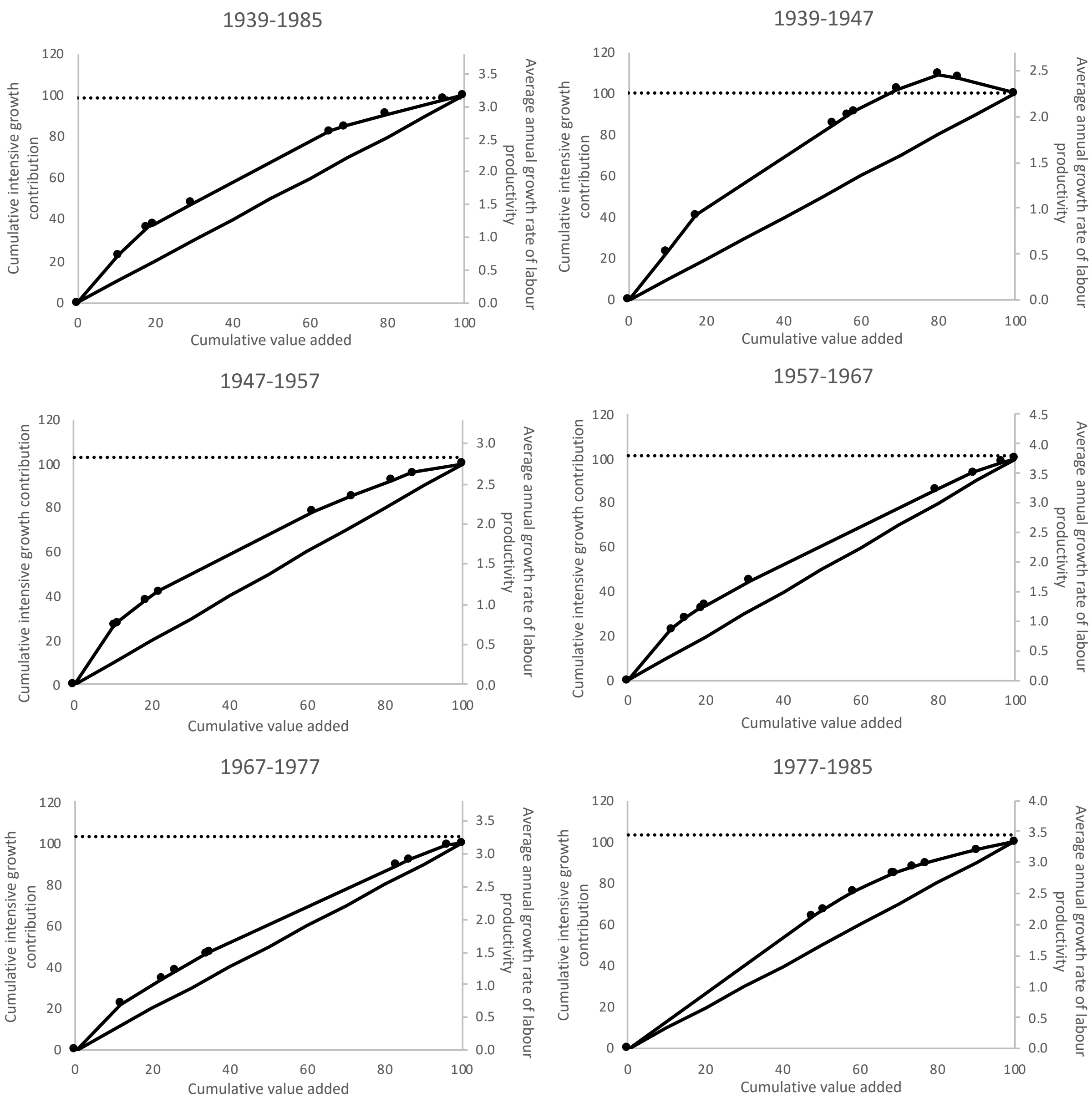
Source: See table XX.

Figures 4.5. Cumulative distribution of intensive growth contribution by industries. Sweden.



Source: See table XX.

Figures 4.6. Cumulative distribution of intensive growth contribution by industries. United States.



Source: See table XX.

4.3. Structural change

The aim of this subsection is to discuss structural change in manufacturing with disaggregated data for Brazil, Chile and Uruguay, compared to developed countries (United States and Sweden).

First, the works of Hirshman (1958) and Rosenstein-Rodan (1943) were based on forward and backward linkages and increasing returns to scale in manufacturing, respectively. Later, in 1960 the famous Kaldor´s law that manufacturing sector is the "engine of growth" strengthened the arguments in favour of manufacturing to achieve a successful economic performance. Furtheromore, as it was already mentioned, structuralist thought since the 1950s emphasized the idea that structural transformations should be concentrated on manufacturing industry.

More recent literature has followed this statement: manufacturing plays a crucial role in economic development and its performance may help us to understand why some countries could catch up while others lagged behind the leaders (Szirmai 2012; Rodrik and McMillan 2011, Rodrik 2015).

Structural change in a broaden sense is defined by Kuznets (1966) as the reallocation of labour from traditional to modern sectors. Applying this concept to the manufacturing sector would mean that structural change is found when there is a shift of labour from lower to more productive industries. Empirically, structural change can be decomposed following the "shift-share" analysis which was originally developed by Fabricant (1942) and proposed later by Fagerberg and Verspagen (1999) and Fagerberg (2000).

For Chile, United States and Sweden the periods are 1939-1950, 1950-1960, 1960-1970 and 1970-1980. For Brazil the first period is 1945-1960, and for Uruguay the periods differ due to data constraint (1939-1947, 1947-1955, 1955-1968, 1968-1978). See Appendix for more details.

This method, and with some variants, was applied for Latin American countries by Timmer and Szirmai (2000), Holland and Porcile (2005)[3], Azar and Fleitas (2010)[4], Rodrik and McMillan (2012), Timmer and de Vries (2009, 2012), Aravena et al (2014),

[3] Holland and Porcile (2005) studied structural change in Brazil, Chile, Colombia, Mexico and Uruguay between 1970 and 2002. In all countries and all periods, the productivity growth was explained primarily for the increases in labour productivity within industries

[4] Azar and Fleitas (2010) descomposed productivity growth in manufacturing sector for Argentina, Brazil, Uruguay and the United States for the period 1930 to 1960. Their results show that for all countries the major source of contribution to aggregate productivity was the within-industry effect. They also identify structural change in the United States and in Brazil during 1939-1959. According to these estimates, in the Southern Cone only Brazil could reduce the heterogeneity among sectors and achieve structural change.

Debowicz and Segal (2014), Colistete and Aldrighi (2015)[5], Arnaut (2017). Some of them analyze structural change at a total economy level. Others focus, as this chapter, on the manufacturing industry.

Chapter 2 showed indicators of structural heterogeneity for some benchmark years. In the case of Uruguay, the evidence is clear that even during the state led industrialization period the composition of value added and employment in manufacturing did not change substantially. Natural resources intensive industries and labour intensive industries always kept a privileged place in Uruguay, and no structural change was observed. On the other side, mainly Brazil and moderately Chile, modified their productive structures, and despite distortions and inefficiencies, the results were a more diversified and technologically complex industrial sector. Towards the late 1960s, in both countries the share of value added and employment of engineering intensive industries were around 35 and 25%, respectively. However, in terms of structural heterogeneity measured by the coefficient of variation, the Brazilian industrial sector showed a better performance than the Chilean.

In this chapter the inclusion of value added at constant prices for different years lets us analyze movements within and between industries over time, which complements the description mentioned above. In the shift-share analysis the increase in overall productivity by taking two points in time is the result of three specific components (Fabricant 1942, Fagerberg, 2000):

$$\frac{(P_t - P_0)}{P_0} = \sum_{n=1}^{i} \Bigg(\underbrace{\frac{S_{i0}\,(P_{it} - P_{i0})}{P_0}}_{\text{(I)}} + \underbrace{\frac{P_{i0}(S_{it} - S_{i0})}{P_0}}_{\text{(II)}} + \underbrace{\frac{(P_{it} - P_{i0})(S_{it} - S_{i0})}{P_0}}_{\text{(III)}} \Bigg)$$

Where P is the labour productivity, i an individual industry, S_i is the share of industry i in total manufacturing, t is the final time period and 0 is the initial time period.

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5 Colistete and Aldrighi (2013) estimated structural change with a shift-share analysis for manufacturing sector in Brazil between 1945 and 2009. One of its most remarkable conclusions is that productivity gains within industries was the major source of aggregate productivity growth since the early industrialization until the 1980s. Moreover, they suggest that the relatively success process of learning and technological advance by manufacturing firms petered out after the lost decade.

Component (I) of the equation is the contribution of productivity growth within industries considering the initial weight of these industries in total labour structure (within-industry effect). Component (II) of the equation shows the change in the employment structure considering the initial fixed productivity and ultimately, the whole effect of the change in productivity due to the reallocation of labour between industries (static effect). Static effect will be positive if the share of high productivity industries in total labour increases at the expense of industries with low productivity. Component (III) is the result of two effects: within-industry and static effect. This component will be positive, if industries which increase their productivity more rapidly than average, also increase their share of total labour. On the contrary, when labour moves to those industries in which labour productivity increases less than average, the contribution of this effect is negative. This component is named as the dynamic effect.

For a shift share analysis it is necessary to build series of value added at constant prices for each country as well labour series by industries. For Brazil the value-added data at constant prices is taken from Colistete (2007) and it is expressed in cruzeiros of 1970. For Sweden this data come from Schön (1988) and is expressed in krones of 1910/12. For Uruguay the series of value added are own estimates expressed in pesos of 1936 (see Appendix XX). For the United States and Chile, the long series of value added at constant prices are own estimates expressed in dollars of 1947 and chilean pesos of 1953, respectively (see Appendix XX).

Table 4.6 shows annual labour productivity growth rates for different subperiods and the shift share results[6]. The three effects (within, static and dynamic) are expressed in percentage, which means that they measure their contribution to total productivity growth.

For each subperiod in Chile, Brazil, US and Sweden, and after 1955 in Uruguay, the aggregate productivity growth was dominated by the within-effect. This result is in line with previous evidence for the Latin American countries (Aldrighi and Colistete 2015, Holland and Porcile 2005, Azar and Fleitas 2010, Arnaut 2017). This means that productivity took place mainly within the prevailing productive structure.

As Aldrighi and Colistete (2013, 2015) have documented, labour productivity in Brazil accelerated in the 1950s and in the 1970s. Annual productivity growth rates were around 7% for both subperiods (table 4.6), much higher than the American and Swedish rates.

[6] Labour productivity growth rates are calculated using those industries which are comparable in the different benchmark years. Thus, they do not have to coincide with the data shown in Table 4.1.

Deliberate industrial policies contributed to develop modern sectors (chemicals, metals, electrical and transport equipment) and also improve productivity in specific traditional sectors, such as textiles. As it was explained in Chapter 3, Vargas' governments employed different instruments to promote industrialization, first based on consumer goods industries and then capital-intensive ones. Later, at the end of the 1960s and over the 1970s, policies were more oriented towards the private sector and also foreign firms, performing very well in terms of labour productivity. Contrary to other small Latin American countries, the large domestic market in Brazil allowed firms to reap the benefits of economies of scale, and made it profitable to produce capital goods, durable consumption goods and transport equipment. Teitel and Thoumi (1986) found that the capital-intensive industries, such as metallurgy and metalworking, increased their volumes of exports and achieved higher efficiency and increased productivity rates. This achievement ran counter to the litany of complaints against import substitution industrialization. Instead it illustrates how the state-led policy fostered development of heavy industries, which played an important role in promoting exports.

This change is reflected in the result of the three effects. First, the within effect represented the highest contribution to total labour productivity growth for each subperiod. On the other side, between 1945 and the 1970s, labour reallocation from less productive to "modern" industries contributed positively to total productivity growth. Since the 1960, despite this movement of labour between industries, a decreasing share of fast-growing productive industries contributed negatively to aggregate productivity. As a result of both effects, structural change measured by the net static effect (static and dynamic effect) was slightly positive between 1945 and the 1970s, and negative in the following decade. Aldrighi and Colistete (2015) obtained similar results for Brazil in this period.

The evidence reported in table 4.6 shows that aggregate labour productivity growth in Chile was around 2-3% per annum over 30 years (1939-1969), whereas it remained stagnant in the 1970s. Although manufacturing in the Andean country was more diversified over the state-led industrialization period (see chapter 3), total productivity growth was mainly led by a higher performance of traditional industries measured by the within-effect. Furthermore, labour productivity growth in paper, non-metallic minerals, and metals, played a key role to explain the within-effect result.

The effect II, labour reallocation, was positive in 1960-1970 and in 1970-1980 in Chile. In the first subperiod the result was explained by metals, and in the second it was due mainly to food and beverage. This result is also consistent with Chapter 3. However, the net static effect was always negative due to a greater negative dynamic effect. The message is that the driver of total productivity growth in the Chilean manufacturing sector did not come from total structural change.

Table 4.6. Decomposition of labour productivity growth in Chile, US, Uruguay, Brazil and Sweden, 1939-1980

1939-1950	Brazil	Chile	Uruguay b/	United States	Sweden
Annual LP growth rate		1.5%	-0.3%	2.7%	1.4%
Within effect		146.3%	18.3%	95.6%	80.3%
Static effect		-38.9%	95.7%	1.6%	17.3%
Dynamic effect		-7.3%	-14.0%	2.8%	2.5%
1950-1960	Brazil a/	Chile	Uruguay b/	United States	Sweden
Annual LP growth rate	7.2%	2.8%	1.9%	2.7%	2.6%
Within effect	91.8%	117.4%	92.7%	102.2%	96.8%
Static effect	5.7%	-9.0%	56.4%	3.0%	2.5%
Dynamic effect	2.5%	-8.4%	-49.1%	-5.3%	0.8%
1960-1970	Brazil	Chile	Uruguay b/	United States	Sweden
Annual LP growth rate	3.0%	2.1%	0.9%	3.8%	7.1%
Within effect	82.9%	106.6%	212.9%	99.8%	91.7%
Static effect	20.3%	2.8%	-34.0%	0.3%	5.9%
Dynamic effect	-3.2%	-9.4%	-78.9%	-0.1%	2.5%
1970-1980	Brazil	Chile	Uruguay b/	United States	Sweden
Annual LP growth rate	7.7%	0.2%	2.0%	2.9%	2.3%
Within effect	103.1%	587.5%	94.4%	104.4%	77.7%
Static effect	1.2%	115.8%	23.8%	-2.6%	19.7%
Dynamic effect	-4.3%	-603.3%	-18.2%	-1.8%	2.6%
1939-1980	Brazil	Chile	Uruguay b/	United States	Sweden
Annual LP growth rate	6.1%	1.6%	1.1%	3.0%	3.3%
Within effect	105.1%	139.3%	151.3%	102.0%	81.9%
Static effect	3.7%	-5.1%	-11.4%	0.0%	4.2%
Dynamic effect	-8.8%	-34.2%	-39.8%	-2.0%	13.9%

Notes: a/For Brazil the first period of analysis is 1945-1960. b/For Uruguay the periods are: 1939-1947, 1947-1955, 1955-1968, 1968-1978 and 1939-1978

Sources: own estimates based on industrial surveys and censuses, yearbooks, Schon for Sweden, Colistete for Brazil.

In Uruguay, the aggregate labour productivity growth rate is negative for the years 1939-1947, and then it rises to 2 per cent for 1947-1955. After that, productivity dropped to 1 per cent per annum and recovered in the 1970s to 2 per cent. Therefore, the labour productivity performance was very modest during almost the whole period, lower than that of Brazil and Chile. This result is in line with the story described in Chapter 3, characterized by a bounded industrialization in Uruguay compared to Brazil and Chile.

With the exception of the first subperiod 1939-1947, in Uruguay the within-effect was the component which contributed more to explain total productivity growth rate. However, it is very important to show what happened with effect II and III. The static effect was positive during 1939-1955, negative between 1955-1968 and positive again in 1968-1978. It means that the sectors which increased their participation in employment were those with higher productivity level than average. Nevertheless, the dynamic effect of structural change always showed a negative contribution. The Uruguayan manufacturing has displaced employment to industries with lower productivity.

As a result, the net static effect reveals a positive contribution between 1947-1955[7], which disappeared in the period 1955 and 1968, and again positive between 1968-1978.

In the United States and Sweden, labour productivity growth rates were always positive and moderate for every subperiod, with higher rates in 1960-1970 (4 per cent annual in the US and 7 per cent in Sweden). In both countries, the effect I reported the higher positive contribution to explain productivity growth rate in each subperiod and the total period. However, while in the Nordic manufacturing industry the static and dynamic effect contributed positively to total productivity, the results are less favourable for the American sectors. Despite a positive static effect during 1939-1970s in the United States, its negative dynamic effect cancelled a total structural change for the subperiods 1950-1960 and 1970-1980s. A dynamic of positive, though mild, structural change could be identified in the US between 1939-1950 and 1960-1970s.

To conclude, structural change measures if the dynamics of the manufacturing industry were able to generate increases in productivity that coincided with the reallocation of labour to those industries that were also more productive. When a process of positive structural change is identified, structural heterogeneity is also reversed.

Uruguay reported the lowest labour productivity growth rates during the period 1930-1980 (1.1 per cent annual), followed by Chile (1.6 per cent annual). On the other side,

[7] This result is consistent with previous works for Uruguay (Bértola 1991, Arnábal, Bertino and Fleitas 2013).

Brazilian productivity grew at the highest rates (6.1 per cent annual), doubling the Swedish and American rates (3.3 per cent and 3.0 per cent, respectively). Moreover, for each subperiod in Chile, Brazil, US and Sweden, and after 1958 in Uruguay, the within effect is the driver of labour productivity growth (effect I).

The effect II reflects the impact of the reallocation of employment in those sectors that present the highest productivity. During the entire period 1939-1980 and by subperiods, the static effect of structural change was positive in Brazil, Sweden and the United States (excepted for the years 1970-1980). It means that in these countries the reallocation of labour was always towards sectors with the higher productivity than average. Conversely, in Chile and Uruguay labour force movements were more volatile and changed over the years; this is why, for the total period, this component records a low and negative contribution.

The importance of effect III is that it measures the changes in the structure of employment and at the same time the changes in labour productivity growth rates by industries. When the effect is positive it shows that both changes were in the same direction. Sweden for the whole period, and Brazil and the United States for certain subperiods (1945-1960 and 1939-1950, respectively), could achieve a positive dynamic effect of structural change. On the other side, in Chile and Uruguay for the whole period, and in Brazil since the 1970s, this effect contributed negatively to aggregate labour productivity growth rate. The positive dynamics observed in the developed countries were identified in a moderate version in Brazil, and were absent in Chile and Uruguay.

This finding for the region may be related to the results obtained for the total economy analysis (Mc Millan and Rodrik, 2012; Castillo and Martins, 2017). In both works, Brazil and Chile recorded positive productivity growth rates during 1950-1975 together with a favourable structural change. However, their performance worsened once they deindustrialized and liberalized their economies since the eighties, and particularly during 1990-2011 structural change was growth-reducing.

4.4. Dynamics of convergence

The unit value ratios presented in Chapter 3 are key in this subsection, as they work as conversion factors which let us compare value added per labour of different countries and in different currencies by manufacturing branches. The UVRs correspond to a benchmark year. Labour productivity gaps between countries by industries are the result of moving time series of labour productivity using at constant prices forwards and backwards (see Appendix).

In this subsection I use an econometric method to estimate convergence or divergence of labour productivity levels. Due to data constraints, labour productivity ratios are taken as a good proxy to measure technological gaps.

The works of Katz (2000), Katz and Stumpo (2001), Muinelo and Pérez (2002), and Lavopa (2011), analyzed convergence between the Latin American countries and the world leaders. All of them employed the PADI-CEPAL[8] database with start in the 1970s and also assumed that industrial paths were a good proxy for technological trajectories.

Besides the assumption that United States was the technological world leader during the period, the Nordic case was included due to its outstanding performance since the 1950s.

Structural convergence of Brazil, Chile and Uruguay is measured by relative labour productivity with respect to the United States and Sweden, at the branch level. To apply this method the data required is value added per employee at constant prices for each branch in every country. Labour productivity levels are expressed in a same currency in order to make comparisons possible[9]. It is thus possible to identify manufacturing sectors which caught up and those who did not.

Following previous works (Matheson and Oxley, 2007; Lavopa, 2011), the technological gap at each industry is defined as the log ratio between the labour productivity (P) of the country under analysis (c) at the industry (i) and the US/Sweden productivity at the same industry:

$$g_{i,t}^{c} = \ln \frac{P_{i,t}^{c}}{P_{i,t}^{us}}$$

Before showing the econometric results, which test convergence over the period, Figures 4.7 to 4.10. let us visually recognize if there seem to be a positive or negative trend in the final series of labour productivity gaps for total manufacturing and several

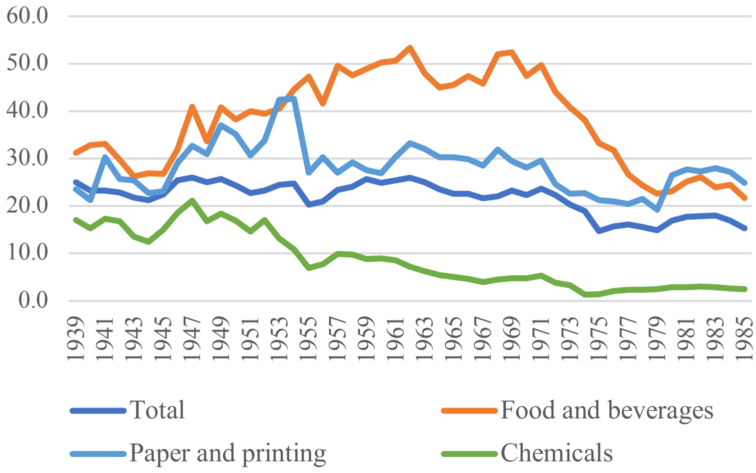
[8]This database is compiled by the Division of Productive Development and Entrepreneurship-CEPAL and is so-called *Programa de Análisis de la Dinámica Industrial (PADI*). The database provides information about value added and employees for Latin American countries since 1970.

[9] Following Lara and Prado (2019) I employ van Ark and Maddison´s unit value ratios calculated for 1975 in the binary comparison Brazil vs US.

industries in Brazil, Chile and Uruguay compared to the US, and Brazil versus Sweden during the selected period. Appendix X presents the estimates.

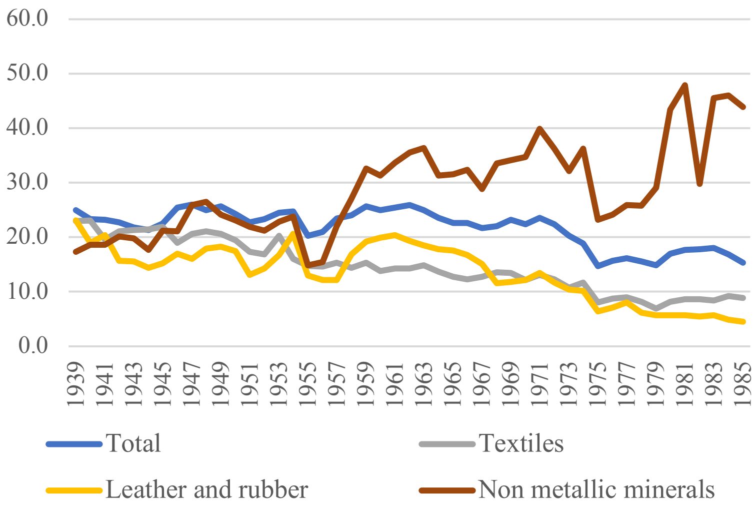
Chilean productivity kept pace with US, until the 1970s, when a sharp decline took place, remaining stable afterwards at a lower level. This general trend, however, was not homogeneous: food and beverages and non-metallic minerals caught up significantly; paper and printing did it during a short period of time to reverse afterwards (also leather and rubber did it); chemicals, as well as textiles, diverged all the time.

Figure 4.7.a. Labour productivity ratio, Chile vs the US



Source: see Appendix XX.

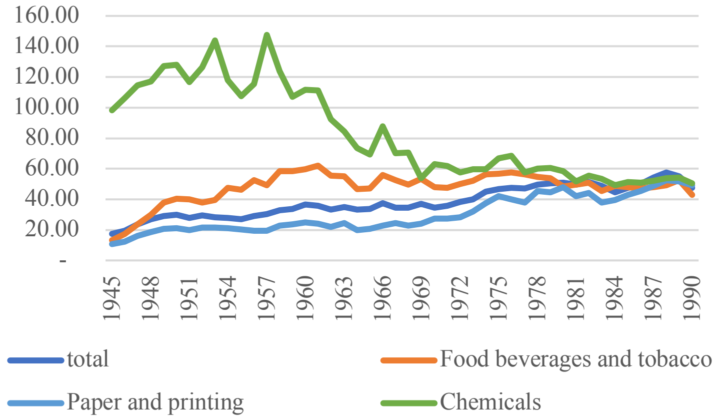
Figure 4.7.b. Labour productivity ratio, Chile vs the US



Source: see Appendix XX.

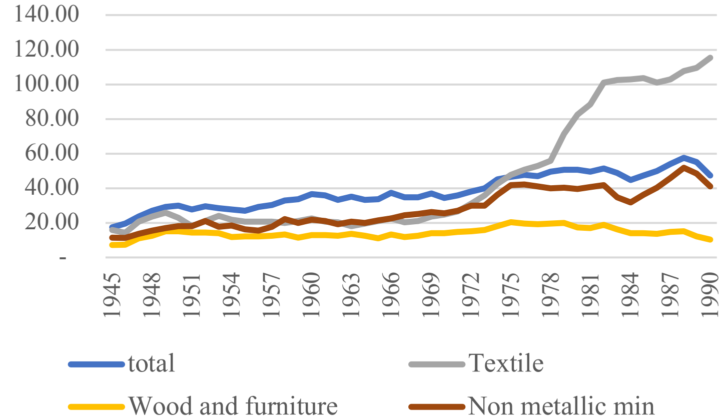
Brazil showed a slow but steady catching up all over the period. Most of its branches did, with the exception of chemicals, and wood and furniture. The early 1960s and early 1980s were the only two periods in which productivity diverged, and this seems to be the case in every branch.

Figure 4.8.a Labour productivity ratio, Brazil vs the US



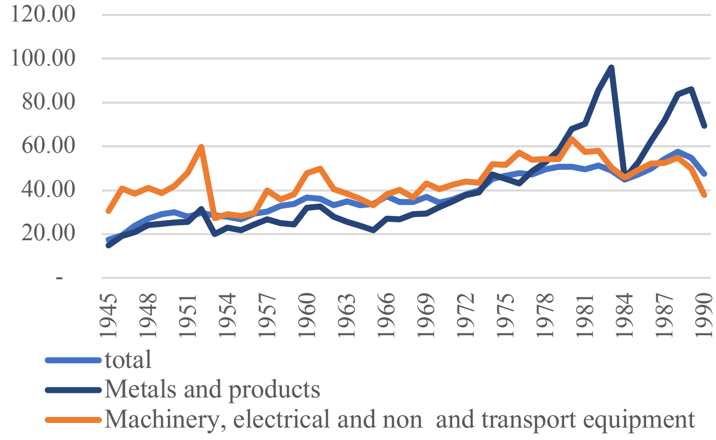
Source: see Appendix XX.

Figure 4.8.b. Labour productivity ratio, Brazil vs the US



Source: see Appendix XX.

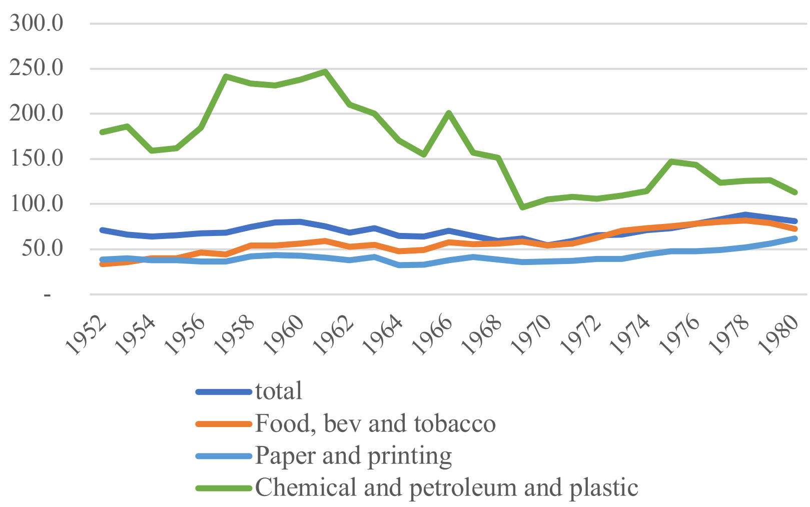
Figure 4.8.c. Labour productivity ratio, Brazil vs the US



Source: see Appendix XX.

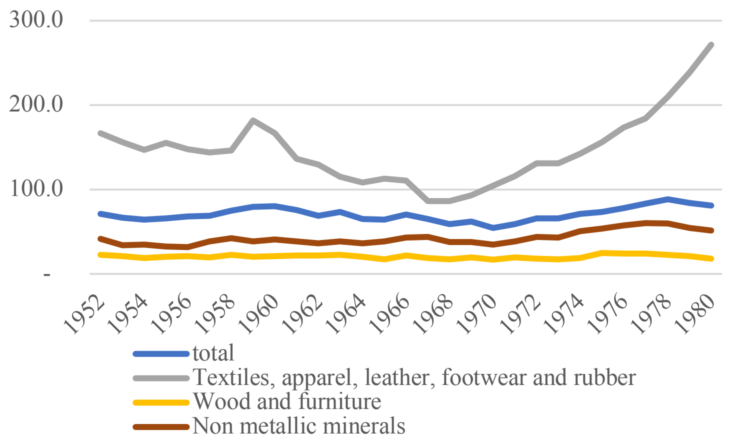
When Brazil is compared to Sweden, the results are less encouraging, however, for some subperiods a catching up process may be visualized for food, beverage and tobacco, paper and printing, textiles, apparel and footwear, and metals. Divergence may seem to be sharp in chemical industry.

Figure 4.9.a. Labour productivity ratio, Brazil vs Sweden



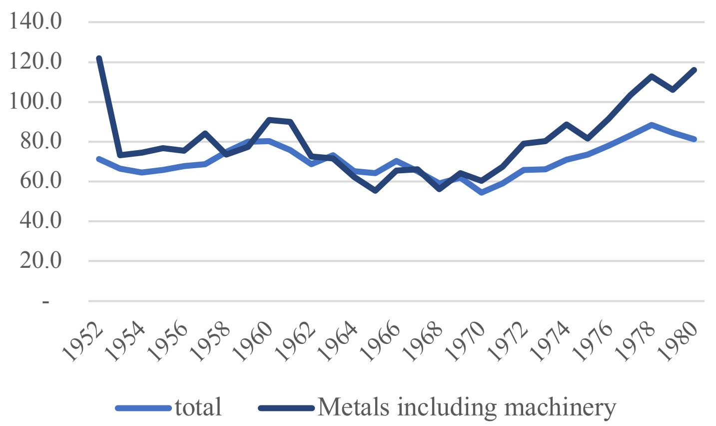
Source: see Appendix XX.

Figure 4.9.b. Labour productivity ratio, Brazil vs Sweden



Source: see Appendix XX.

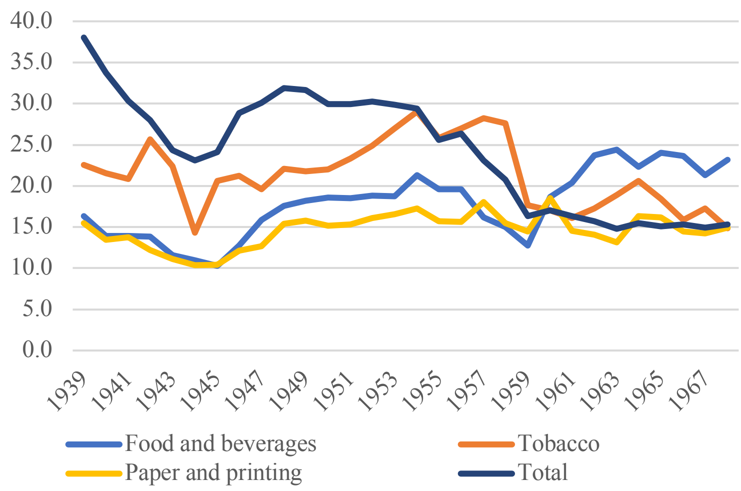
Figure 4.9.c. Labour productivity ratio, Brazil vs Sweden



Source: see Appendix XX.

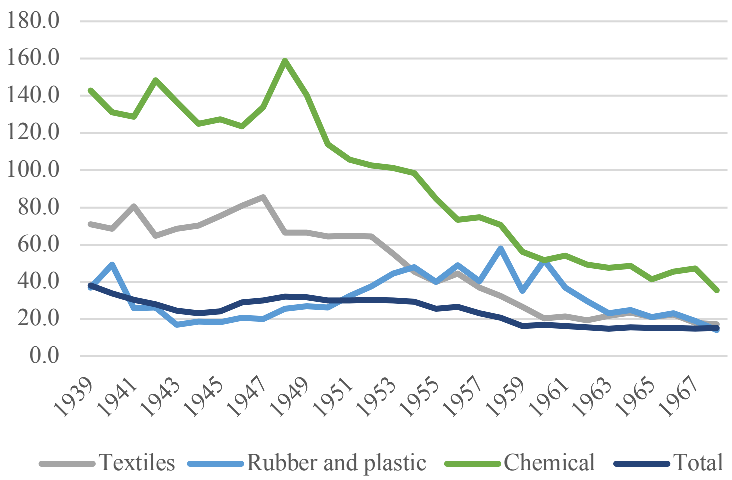
Finally, Uruguayan total productivity levels remained rather stable while the economy was growing up to the 1960s, with the exception of the years of WWII. Again, this average trend was the result of quite different trends: tobacco and food and beverages, paper and printing and rubber and plastic performed rather well until the 1950s; while chemicals and textiles diverged sharply. Chemicals is a particular case, as they lost an original advantage and ended at very low comparative levels. Although this trend does not show an outstanding performance during the industrialization period, the comparative labour productivity levels remained higher than the result obtained for the benchmark year in 1988 (14.8 per cent of American labour productivity).

Figure 4.10.a. Labour productivity ratio, Uruguay vs US



Source: see Appendix XX.

Figure 4.10.b. Labour productivity ratio, Uruguay vs US



Source: see Appendix XX.

Test of convergence or divergence of the technological gap

Augmented Dickey-Fuller test is one of the best-known and most widely used unit root tests (Stock and Watson 2012). In this case, the procedure consists of using a model with constant and deterministic trend in order to test whether the technological gap tends to narrow (convergence) or widen (divergence) over time.

$$\Delta g_{i,t}^{c} = \beta_i + \gamma_i t + \alpha_i g_{i,t-1}^{c} + \sum_{j=1}^{p} \varphi_{ij} \Delta g_{i,t-j}^{c} + u_{i,t}$$

where, t is a linear time trend, φ is the lag structure of the ADF test[10] and u is the error term.

If, with the ADF contrast, there is no unit root evidence (the null hypothesis is rejected), it is concluded that there could be a convergence or divergence relationship between these countries. If the existence of a unit root is detected (the null hypothesis is not rejected), the convergence or divergence hypothesis is discarded.

If it is concluded that the series has a stationary evolution (not detecting unit root), the conclusion as to whether there is a convergence or divergence relationship will depend on the nature of the deterministic components of the series. Following Matheson and Oxley (2007), the nature of its components is analyzed from the estimation of the following model:

$$g_{i,t}^{c} = \beta_i + \gamma_i t + \varepsilon_{i,t} \qquad (1)$$

If γ_i turns out to be significant and positive, the conclusion is that there is convergence. On the contrary, if γ_i is significant and negative, the relationship would be divergence.

Perron (1989) shows that the ADF test can lead to erroneous conclusions in cases where the series presents some structural breakdown, given the low power of the test when the alternative hypothesis is specified incorrectly. It incorporates an exogenous structural break to the ADF contrast and rejects the unit root hypothesis in series in which the traditional ADF contrast was not rejected. Therefore, in case of structural break, the process could be stationary despite not rejecting the unit root hypothesis with the ADF test.

Unit root test when there is a structural breakdown

Zivot and Andrews (1992) return to Perron's analysis and define an iterative methodology for testing unit root in the event of a structural break. Unlike Perron, they do not define the breaking point, but consider the possibility of it being determined by the data, i.e. endogenously. The breaking point is determined by minimizing the test statistic $\hat{\alpha}^{i} = 1$ with i=A, B, C. This procedure has the advantages that it does not require

[10] As Stata programme does not suggest the lag structure of the ADF test, the selection of the number of lags was determined by the Akaike criterion. The advantages of this criterion are found in Stock and Watson (2012).

knowing the possible structural breaking point beforehand, and that it is more restrictive to reject the null hypothesis.

The null hypothesis is the existence of a unit root process without structural change. The alternative hypothesis is a stationary trend process with an unknown structural breaking point. Three models are tested: model (A) proposes the existence of a break in the level of the series, model (B) a break in the growth rate, and model (C) both breakdowns.

$$A)\quad g_{i,t}^{c} = \hat{\mu}^{A} + \hat{\theta}^{A} DU_{i,t}(\hat{\lambda}) + \hat{\beta}^{A} t + \hat{\alpha}^{A} g_{i,t-1}^{c} + \sum_{j=1}^{k} \hat{c}_j^{A}\, \Delta g_{i,t-j}^{c} + \hat{e}_{i,t}$$

$$B)\quad g_{i,t}^{c} = \hat{\mu}^{B} + \hat{\beta}^{B} t + \hat{\gamma}^{B} DT_{i,t}(\hat{\lambda}) + \hat{\alpha}^{B} g_{i,t-1}^{c} + \sum_{j=1}^{k} \hat{c}_j^{B}\, \Delta g_{i,t-j}^{c} + \hat{e}_{i,t}$$

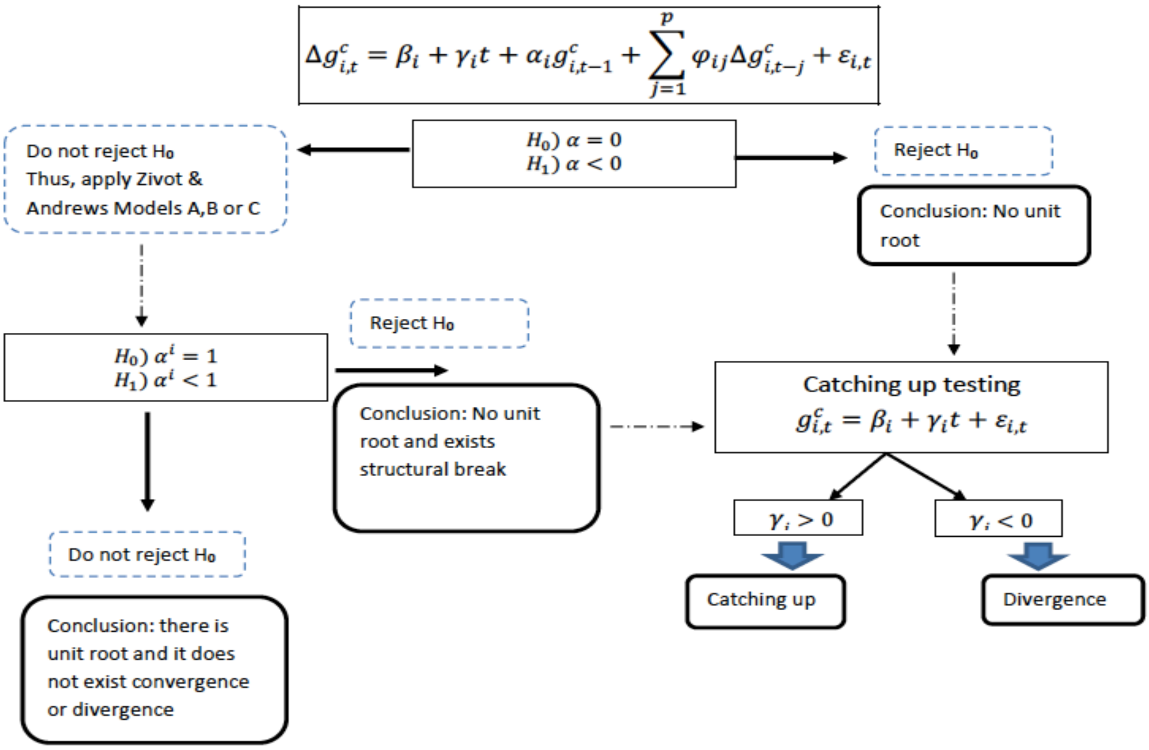
$$C)\quad g_{i,t}^{c} = \hat{\mu}^{C} + \hat{\theta}^{C} DU_{i,t}(\hat{\lambda}) + \hat{\beta}^{C} t + \hat{\gamma}^{C} DT_{i,t}(\hat{\lambda}) + \hat{\alpha}^{C} g_{i,t-1}^{c} + \sum_{j=1}^{k} \hat{c}_j^{C}\, \Delta g_{i,t-j}^{c} + \hat{e}_{i,t}$$

Where $DU_{i,t}(\hat{\lambda}) = 1$ if $t > T\hat{\lambda}$, 0 otherwise; $DT_{i,t}(\hat{\lambda}) = t - T\hat{\lambda}$ if $t > T\hat{\lambda}$, 0 otherwise; and $\hat{\lambda}$ is the break fraction. T is the sample size.

If the ZA test concludes that the series is stationary around a trend with a structural break (rejects the unit root hypothesis), the existence of convergence or divergence in the model (1) is analyzed separately in the two periods before and after the structural break.

Figure 4.11 summarizes the procedure followed with the time series to test catching up over the period or during subperiods.

Figure 4.11 Procedure to test catching up



Source: own elaboration based on Matheson and Oxley.

Table 4.7 shows the main results obtained from Augmented Dickey Fuller and Zivot and Andrews tests. When convergence and/or divergence is observed over the period or in subperiods, the results of the deterministic trend are presented in this table as well.

For manufacturing at large, there was no catching up evidence in the comparison Chile vs US (1939-1985), Uruguay vs US (1939-1968) and Brazil vs Sweden (1952-1980).[11] On the contrary, Brazil showed a statistically significant convergence process as compared to the United States over the period (1945-1990).

At industry level, in the binary comparison Chile vs US, the evidence is not conclusive of a divergence or convergence process for the whole period. After using ZA test in chemicals, textiles, tobacco and leather and rubber, different stationary paths were identified for short periods. The breaking points were 1974, 1975, 1950 and 1958,

[11] Although the sample size is short in the comparisons Uruguay vs US and Brazil vs Sweden, ADF test does not report inconsistency (Stock and Watson 2012) and Zivot and Andrews presents different tests in order to deal especially with small samples (Zivot and Andrews 1992).

respectively. Before the breaking year, there was a divergence trend, and after that it changed towards a catching up process, with the exception of leather and rubber. In this latter case, the break year in 1958 only marked a more profound divergence path.

In the binary comparison Brazil versus United States, the evidence always presents a conclusive result mainly through a positive significant coefficient for the whole period or a subperiod. Using the ADF test, non-metallic minerals showed the best performance in terms of catching-up with the leader; whereas food and beverage also converged but in a quite slower growth rate. Furthermore, when introducing the structural breaks test, textiles, paper and printing, metals and machinery, managed to reduce their gap before and after the breaking years (1964, 1973, 1966 and 1953 respectively) but at different rates. Only in chemicals the picture was different, in 1962 the performance of this industry shifted towards a statistically significant divergence trend. By far, these results are more favourable than those found by Lavopa for the period 1970-2005. A strong industrialization in Brazil let industries catch up with the US. Son períodos diferentes con políticas diferentes

However, when comparing Brazil with Sweden the results are less encouraging. Disaggregated by industries, using Zivot and Andrews test it is evidenced that only metals managed to reduce their gap with Sweden restricted to the period 1965-1980, and in wood and furniture the divergence trend is statistically significant before and after 1975. In the remaining industries, it is not possible to conclude on a statistically significant convergence or divergence trend.

Finally, the Uruguay vs US comparison shows divergence results using ZA test in paper and printing, rubber, and tobacco. Conversely, only food and beverages industry records a convergence trend before and after the breaking point in 1957. In the remaining industries, it is not possible to conclude on a statistically significant convergence or divergence trend.

In sum, the most successful cases of catching-up were concentrated mainly in the comparison Brazil versus the United States. This is consistent with the results obtained in the previous subsections of this chapter as well as the main hypothesis presented in this thesis. Moreover, in Chile chemicals, textiles, and tobacco could achieve a better performance after a turning point, and in Uruguay it was evidenced in food and beverages and tobacco.

Table 4.7. ADF tests, Zivot and Andrews test, and deterministic trend estimates. Chile, Brazil and Uruguay compared to US, and Brazil compared to Sweden.

	ADF Trend & constant	Zivot and Andrews	Deterministic trend			
			γ_i	Break year	$\gamma_{i(to-t*)}$	$\gamma_{i(t*-T)}$
Chile vs US 1939-1985						
Manufacturing						
Chemicals		-5.55 (**)		1974	-0.050(***)	0.046(**)
Food&beverage						
Textiles		-6.67 (***)		1975	-0.02(***)	0.007
Tobacco		-5.25 (**)		1950	-0.0001	0.013(***)
Paper & printing						
Non metalmineral						
Leather& rubber		-5.54 (**)		1958	-0.018(***)	-0.063(***)
Brazil vs US 1945-1990						
Manufacturing	-4.15(**)		0.019 (***)			
Chemicals		-5.17 (**)		1962	0.003	-0.015(***)
Food & beverage	-5.01(***)		0.011 (***)			
Textiles		-4.66 (**)		1964	0.004	0.081 (***)
Paper & printing		-4.84 (*)		1973	0.019(***)	0.014 (***)
Non metalmineral	-3.26 (*)		0.029 (***)			
Metals		-4.48 (**)		1966	0.014(**)	0.046(***)
Machinery		-4.97 (*)		1953	0.068(***)	0.013(***)
Wood&furniture						
Brazil vs Sweden 1952-1980						
Manufacturing						
Chemicals						
Food&beverage						
Textiles						
Paper & printing						
Non metalmineral						
Metals		-6.27 (**)		1964	-0.013	0.049(***)
Wood&furniture		-4.87 (*)		1975	-0.008(***)	-0.066(**)
Uruguay vs US 1939-1968						
Manufacturing						
Chemicals						
Food&beverage		-4.82 (**)		1957	0.03 (***)	0.047 (***)
Textiles						
Paper&printing		-4.90 (**)		1948	-0.03 (*)	-0.005
Rubber&plastic		-4.58 (**)		1959	0.035 (**)	-0.129 (***)
Tobacco		-4.94 (**)		1959	0.017 (***)	-0.008

Source: own estimates.

4.5. Conclusions

New evidence of patterns of industrial growth, structural change and dynamics of convergence for Latin American countries in a comparative perspective has been shown and discussed in this chapter.

Harberger diagrams showed that Brazil, Sweden and United States performed a yeasty industry pattern, while in Chile and Uruguay both yeasty and mushroom growth process occurred over the period. In addition, observing the results for every country and every subperiod when labour productivity growth rates increases, the industry pattern becomes more balanced and on the contrary, when labour productivity growth rate decreases, the process is more concentrated in less industries (with the exception of US in the last subperiod). In other words, the brakes to productivity increases go hand in hand with more concentrated industry patterns.

Furthermore, the shift-share analysis let us conclude that labour productivity took place mainly within the prevailing productive structure. For each subperiod in Chile, Brazil, US and Sweden, and after 1955 in Uruguay, the aggregate productivity growth was dominated by the within-effect. This result is in line with previous evidence for the Latin American countries (Aldrighi and Colistete 2015, Holland and Porcile 2005, Azar and Fleitas 2010, Arnaut 2017).

During part of the industrialization period, in Chile and Uruguay mostly gains obtained by the static effect of structural change were more than cancelled by the dynamic effect, that is, the largest negative contribution to productivity comes from the joint effect of the change in the structure of employment towards sectors that show a lower growth rate of productivity. However, Brazil managed to partially reduce its structural heterogeneity in manufacturing until the 1970s; whereas Sweden showed the best performance over the whole period.

From the procedure to test convergence I conclude that there is no catching up evidence in the comparison Chile vs US (1939-1985), Uruguay vs US (1939-1968) and Brazil vs Sweden (1952-1980) for manufacturing at large. On the contrary, Brazil showed a statistically significant convergence process as compared to the United States over the period (1945-1990). Brazil carried out industrial and technological policies, which contributed to an extent to transform the productive structure and reduce the productivity differences from the country leader. Gap reduction and structural change may seem to go hand in hand.

However, the convergence analysis disaggregated by industries let us recognize successful cases of catching-up. Most of them were concentrated mainly in the comparison Brazil versus the United States. Moreover, in Chile chemicals, textiles, and tobacco could achieve a better performance after a turning point, and in Uruguay it was evidenced in food and beverages and tobacco.

APPENDIX (Incomplete)

Table A4.1. Concentration of labour productivity growth by industries. Brazil, 1949-1980

Brazil 1949-1980	LP growth annual rate	VA 1949	Cum relative VA share	RCR	Cum intensive growth cont
Textiles	8.4	9,358,541	19.9	104,303,073	49.5
Leather and rubber and apparel	5.7	3,684,998	27.7	17,163,874	57.7
Tobacco	5.7	680,436	29.2	3,101,222	59.2
Non metallic minerals	5.3	3,410,777	36.5	13,427,855	65.5
Paper and printing	5.2	2,971,532	42.8	11,268,231	70.9
Metals	4.9	7,312,336	58.3	24,694,523	82.6
Food and beverages	3.6	11,920,778	83.7	24,146,050	94.1
Chemicals	3.3	4,626,249	93.5	8,041,141	97.9
Wood and furniture	2.9	3,038,326	100.0	4,403,069	100.0
Brazil 1949-1959	LP growth annual rate	VA 1949	Cum relative VA share	RCR	Cum intensive growth cont
Food and beverages	6.3	11,920,778	25.4	10,012,585	39.2
Chemicals	6.2	4,626,249	35.2	3,798,641	54.1
Leather and rubber and apparel	5.4	3,684,998	43.0	2,561,299	64.2
Tobacco	5.0	680,436	44.5	426,791	65.8
Non metallic minerals	4.6	3,410,777	51.7	1,941,127	73.4
Paper and printing	4.0	2,971,532	58.1	1,429,473	79.0
Textiles	3.1	9,358,541	78.0	3,350,579	92.2
Metals	2.1	7,312,336	93.5	1,650,507	98.6
Wood and furniture	1.1	3,038,326	100.0	347,983	100.0
Brazil 1959-1970	LP growth annual rate	VA 1959	Cum relative VA share	RCR	Cum intensive growth cont
Tobacco	8.4	7,048,930	1.3	10,080,536	4.0
Textiles	6.0	64,839,021	13.5	58,692,993	27.3
Wood and furniture	4.8	29,359,198	19.0	19,651,858	35.1
Non metallic minerals	4.5	35,509,439	25.7	21,839,845	43.8
Metals	4.3	145,105,415	53.0	86,511,798	78.1
Paper and printing	4.0	32,249,281	59.0	17,157,995	84.9
Leather and rubber and apparel	2.3	45,757,380	67.6	12,876,221	90.0
Food and beverages	1.4	104,612,213	87.3	17,920,760	97.1
Chemicals	0.9	67,622,074	100.0	7,207,651	100.0
Brazil 1970-1980	LP growth annual rate	VA 1970	Cum relative VA share	RCR	Cum intensive growth cont
Textiles	16.7	4,976,927	9.5	18,385,423	30.6
Leather and rubber and apparel	10.0	4,164,779	17.5	6,683,640	41.7
Metals	8.4	17,026,237	50.2	21,065,322	76.7
Paper and printing	7.8	3,322,361	56.5	3,694,241	82.9
Non metallic minerals	6.9	3,134,408	62.6	2,971,775	87.8
Tobacco	3.5	699,831	63.9	283,768	88.3
Food and beverages	3.5	8,412,905	80.0	3,397,862	94.0
Chemicals	3.1	7,957,409	95.3	2,854,663	98.7
Wood and furniture	2.8	2,459,279	100.0	778,042	100.0
Brazil 1980-1990	LP growth annual rate	VA 1970	Cum relative VA share	RCR	Cum intensive growth cont
Textiles	6.6	251,520,048	6.7	224,558,750	30.8
Non metallic minerals	3.1	228,554,620	12.7	81,996,834	42.0
Tobacco	2.3	26,920,740	13.4	6,893,134	42.9
Paper and printing	2.0	221,035,150	19.3	47,169,440	49.4
Metals	1.8	1,398,071,729	56.3	267,008,675	86.0
Chemicals	1.6	675,630,929	74.2	113,447,177	101.5
Food and beverages	0.9	442,288,804	86.0	42,419,747	107.3
Leather and rubber and apparel	-0.2	354,082,327	95.3	-7,212,521	106.3
Wood and furniture	-3.0	175,914,745	100.0	-46,152,214	100.0

Source: own estimates based on industrial censuses and Colistete (2009).

Table A4.2. Concentration of labour productivity growth by industries. Chile, 1939-1985

Chile 1939-1985	LP growth annual rate	VA 1939	Cum relative VA share	RCR	Cum intensive growth cont
Non metallic minerals	4.6	81,122,525	5.0	571,317,827	21.0
Tobacco	3.8	114,539,013	12.0	536,426,795	40.7
Metals	3.2	132,287,866	20.2	426,841,986	56.4
Paper and printing	2.5	131,711,878	28.3	271,993,538	66.4
Textiles	2.2	270,216,879	44.9	469,082,146	83.6
Food and beverages	1.3	451,412,026	72.6	365,209,421	97.0
Chemicals	1.0	183,501,471	83.9	105,442,577	100.9
Leather and rubber and apparel	0.4	168,452,405	94.3	37,553,136	102.3
Wood and furniture	-2.4	93,489,566	100.0	-62,660,232	100.0
Chile 1939-1947	**LP growth annual rate**	**VA 1939**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
			0		0
Non metallic minerals	8.1	81,122,525	5.0	70,424,889	14.3
Paper and printing	6.6	131,711,878	13.1	88,175,373	32.1
Tobacco	5.5	114,539,013	20.1	61,774,575	44.6
Metals	5.0	132,287,866	28.3	62,721,706	57.3
Textiles	3.6	270,216,879	44.9	89,056,803	75.4
Chemicals	3.6	183,501,471	56.1	60,187,416	87.5
Food and beverages	2.0	451,412,026	83.9	77,703,961	103.3
Leather and rubber and apparel	0.7	168,452,405	94.3	10,253,405	105.4
Wood and furniture	-4.1	93,489,566	100.0	-26,445,492	100.0
Chile 1947-1957	**LP growth annual rate**	**VA 1947**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Metals	3.0	1,243,004,660	11.8	434,820,653	33.0
Food and beverages	2.9	2,495,000,558	35.4	833,904,048	96.2
Non metallic minerals	1.6	783,997,354	42.8	135,978,768	106.5
Textiles	0.9	1,995,329,360	61.7	187,713,304	120.7
Paper and printing	0.2	657,033,247	67.9	13,767,132	121.8
Tobacco	-0.0	590,973,310	73.5	-1,460,312	121.7
Leather and rubber and apparel	-0.2	1,024,903,511	83.2	-20,133,242	120.1
Chemicals	-0.7	1,243,004,660	95.0	-84,536,091	113.7
Wood and furniture	-4.1	531,203,935	100.0	-181,039,937	100.0
Chile 1957-1967	**LP growth annual rate**	**VA 1957**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Tobacco	7.8	16,327,000,000	5.4	18,159,797,672	15.6
Leather and rubber and apparel	5.9	31,221,900,000	15.9	23,913,157,244	36.1
Wood and furniture	4.7	14,465,000,000	20.7	8,517,913,026	43.4
Non metallic minerals	4.5	15,858,000,000	26.0	8,886,011,251	51.0
Paper and printing	3.6	16,911,300,000	31.6	7,291,014,790	57.3
Textiles	3.3	40,197,900,000	45.0	15,230,651,891	70.3
Food and beverages	2.9	68,648,200,000	67.9	22,780,741,991	89.9
Metals	1.5	62,651,300,000	88.9	10,394,202,395	98.8
Chemicals	0.4	33,406,000,000	100.0	1,424,995,833	100.0
Chile 1967-1979	**LP growth annual rate**	**VA 1967**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Tobacco	3.8	257,302,300,000	2.7	145,235,139,971.7	19.7
Metals	3.3	3,439,069,200,000	38.1	1,637,498,189,585.5	241.8
Non metallic minerals	2.5	314,994,700,000	41.3	110,379,753,052.8	256.7
Chemicals	1.7	905,274,400,000	50.6	199,149,119,808.3	283.7
Textiles	-1.1	992,483,000,000	60.9	-124,630,961,806.6	266.8
Paper and printing	-1.3	472,562,100,000	65.7	-67,390,910,211.3	257.7
Food and beverages	-2.6	2,084,860,300,000	87.2	-568,504,378,627.1	180.6
Leather and rubber and apparel	-4.8	853,889,100,000	96.0	-377,786,404,355.3	129.4
Wood and furniture	-6.6	387,109,100,000	100.0	-216,551,255,483.2	100.0
Chile 1979-1985	**LP growth annual rate**	**VA 1979**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Non metallic minerals	9.7	7,435,963	3.6	5,511,292	11.5
Textiles	7.7	11,259,481	9.0	6,304,085	24.7
Paper and printing	6.6	17,768,383	17.5	8,271,972	42.0
Metals	3.6	59,971,856	46.3	14,046,191	71.3
Leather and rubber and apparel	3.0	17,409,735	54.7	3,381,530	78.4
Food and beverages	3.0	48,604,242	78.0	9,436,725	98.1
Tobacco	1.9	7,754,878	81.7	930,981	100.1
Chemicals	0.0	28,640,664	95.5	4,597	100.1
Wood and furniture	-0.1	9,463,804	100.0	-33,313	100.0

Source: own estimates based on industrial censuses, surveys and yearbooks.

Table A4.3. Concentration of labour productivity growth by industries. Uruguay, 1936-1978

Uruguay 1936-1978	LP growth annual rate	VA 1936	Cum relative VA share	RCR	Cum intensive growth cont
Paper	3.6	1,251,986	1.8	4,286,992	5.1
Tobacco	3.3	3,488,007	6.7	10,179,088	17.3
Non metallic minerals	3.3	4,539,654	13.1	12,996,331	32.8
Rubber	2.6	685,722	14.1	1,366,982	34.4
Food	2.3	26,562,900	51.5	42,013,021	84.5
Beverage	1.7	12,016,824	68.5	12,179,835	99.1
Printing	1.6	3,667,377	73.6	3,428,778	103.2
Chemical	0.5	4,234,193	79.6	935,301	104.3
Textiles	0.3	7,223,327	89.8	848,608	105.3
Metallurgic	0.1	679,223	90.8	25,286	105.3
Apparel and footwear	-2.7	6,546,125	100.0	- 4,471,223	100.0

Uruguay 1936-1955	LP growth annual rate	VA 1936	Cum relative VA share	RCR	Cum intensive growth cont
Rubber	6.5	685,722	0.8	1,589,643.47	7.9
Tobacco	4.4	3,488,007	4.9	4,442,004.96	29.8
Non metallic minerals	2.6	4,539,654	10.3	2,798,837.21	43.6
Printing	2.2	3,667,377	14.6	1,900,992.66	53.0
Leather	2.0	4,894,996	20.4	2,299,664.35	64.4
Paper	1.5	1,251,986	21.9	413,196.82	66.4
Metallurgic	1.5	679,223	22.7	221,172.27	67.5
Food	1.0	26,562,900	54.1	5,454,542.45	94.5
Wood and furniture	0.8	3,534,871	58.3	597,552.35	97.4
Beverage	0.7	12,016,824	72.5	1,748,961.32	106.0
Textiles	0.3	7,223,327	81.0	480,279.83	108.4
Chemical	0.2	4,234,193	86.0	172,944.88	109.3
Electrical machinery	0.1	786,413	86.9	17,421.24	109.4
Apparel and footwear	-0.8	6,546,125	94.7	- 974,953	104.5
Vehicle	-1.2	4,512,157	100.0	- 918,849	100.0

Uruguay 1955-1968	LP growth annual rate	VA 1955	Cum relative VA share	RCR	Cum intensive growth cont
Paper	7.3	16	1.8	24	10.4
Food	6.6	213	26.1	276	128.7
Beverage	1.7	125	40.4	31	142.0
Non metallic minerals	1.0	77	49.1	11	146.7
Chemical	0.2	58	55.8	1	147.3
Tobacco	0.2	24	58.5	1	147.6
Printing	-0.8	37	62.7	- 4	146.0
Textiles	-1.7	113	75.6	- 22	136.5
Metallurgic	-2.0	70	83.6	- 16	129.4
Petroleum	-4.6	73	91.9	- 34	115.0
Apparel and footwear	-4.9	49	97.5	- 24	104.9
Rubber	-5.5	22	100.0	- 11	100.0

Uruguay 1968-1978	LP growth annual rate	VA 1968	Cum relative VA share	RCR	Cum intensive growth cont
Petroleum	7.7	2,177,937	2.8	2,386,342	10.9
Non metallic minerals	7.7	4,771,514	9.0	5,211,293	34.8
Rubber	6.5	4,423,562	14.8	3,901,560	52.7
Tobacco	5.4	4,919,158	21.2	3,368,041	68.1
Printing	3.5	2,261,128	24.1	937,544	72.4
Beverage	3.5	7,378,418	33.7	3,018,632	86.3
Paper	2.8	1,330,991	35.4	430,863	88.2
Textiles	2.7	14,356,304	54.1	4,365,472	108.2
Chemical	1.4	6,787,502	62.9	975,435	112.7
Metallurgic	0.2	5,164,222	69.6	113,393	113.2
Food	- 0.7	17,325,054	92.1	- 1,166,334	107.9
Apparel and footwear	- 3.3	6,102,938	100.0	- 1,721,050	100.0

Sources: own estimates based on industrial censuses, and other official statistics.

Table A4.4. Concentration of labour productivity growth by industries. Sweden, 1939-1979

Sweden 1930-1980	LP growth annual rate	VA 1930	Cum relative VA share	RCR	Cum intensive growth cont
Chemicals	4.0	88	3.4	545.47	7.3
Non metallic minerals	4.0	157	9.5	944.74	20.0
Leather and rubber and apparel	3.5	160	15.8	751.51	30.0
Metals	3.0	842	48.6	2,890.66	68.8
Paper and printing	2.7	339	61.8	922.82	81.1
Wood and furniture	2.5	251	71.6	593.82	89.1
Textiles	2.1	370	86.0	650.83	97.8
Food and beverages and tobacco	0.8	359	100.0	164.70	100.0

Sweden 1930-1939	LP growth annual rate	VA 1930	Cum relative VA share	RCR	Cum intensive growth cont
Non metallic minerals	5.1	157	6.1	89	16.0
Chemicals	4.2	88	9.5	39	23.1
Paper and printing	2.9	339	22.8	101	41.2
Metals	2.7	842	55.6	229	82.4
Food and beverages and tobacco	1.4	359	69.6	48	91.1
Wood and furniture	1.2	251	79.3	29	96.3
Leather and rubber and apparel	0.6	160	85.6	10	98.0
Textiles	0.3	370	100.0	11	100.0

Sweden 1939-1949	LP growth annual rate	VA 1939	Cum relative VA share	RCR	Cum intensive growth cont
Leather and rubber and apparel	3.2	184	4.6	68.6	52.9
Non metallic minerals	2.1	208	9.9	48.6	90.4
Chemicals	1.0	165	14.1	18.1	104.4
Paper and printing	1.0	424	24.8	46.5	140.2
Wood and furniture	1.0	343	33.4	36.8	168.6
Food and beverages and tobacco	0.8	443	44.6	38.8	198.5
Textiles	- 0.4	507	57.4	-18.3	184.3
Metals	- 0.7	1,688	100.0	-109.4	100.0

Sweden 1949-1959	LP growth annual rate	VA 1949	Cum relative VA share	RCR	Cum intensive growth cont
Metals	4.6	3,874	41.4	2,177.2	85.3
Non metallic minerals	4.5	428	46.0	236.4	94.5
Chemicals	3.8	455	50.9	206.8	102.6
Leather and rubber and apparel	2.9	432	55.5	143.2	108.3
Paper and printing	1.3	1,006	66.3	134.0	113.5
Wood and furniture	1.1	727	74.1	83.9	116.8
Food and beverages and tobacco	-0.8	1,102	85.8	- 81.2	113.6
Textiles	-3.0	1,323	100.0	- 347.3	100.0

Sweden 1959-1969	LP growth annual rate	VA 1959	Cum relative VA share	RCR	Cum intensive growth cont
Textiles	12.0	1,626	8.0	3,403.6	18.1
Leather and rubber and apparel	9.1	630	11.1	876.3	22.8
Chemicals	8.1	1,196	17.0	1,415.1	30.3
Metals	6.8	10,139	66.8	9,412.0	80.5
Wood and furniture	5.8	1,366	73.5	1,041.1	86.0
Non metallic minerals	5.6	899	77.9	656.7	89.5
Paper and printing	5.0	2,358	89.5	1,492.7	97.5
Food and beverages and tobacco	2.0	2,131	100.0	474.4	100.0

Sweden 1969-1979	LP growth annual rate	VA 1969	Cum relative VA share	RCR	Cum intensive growth cont
Paper and printing	3.9	5,471	12.4	2,529.0	23.7
Wood and furniture	3.4	3,836	21.2	1,502.3	37.7
Chemicals	3.2	2,967	27.9	1,093.1	48.0
Non metallic minerals	3.0	2,019	32.5	697.1	54.5
Textiles	1.8	2,317	37.8	461.8	58.8
Leather and rubber and apparel	1.8	1,089	40.3	216.1	60.9
Metals	1.7	21,614	89.4	4,002.3	98.3
Food and beverages and tobacco	0.4	4,654	100.0	177.7	100.0

Source: own estimates based on industrial censuses and Schön, Industri och hantverk 1800-1980.

Table A4.5. Concentration of labour productivity growth by industries. United States, 1939-1985

US 1939-1985	LP growth annual rate	VA 1939	Cum relative VA share	RCR	Cum intensive growth cont
Chemicals	4.7	2,555	10.7	18,868	22.9
Textiles	4.3	1,822	18.2	11,020	36.2
Tobacco	3.4	350	19.7	1,265	37.8
Leather and rubber and apparel	3.3	2,371	29.6	8,348	47.9
Metals	3.3	8,543	65.2	28,678	82.7
Non metallic minerals	2.5	911	69.0	1,974	85.0
Paper and printing	2.3	2,636	80.0	5,011	91.1
Food and beverages	2.1	3,556	94.8	5,696	98.0
Wood and furniture	1.8	1,245	100.0	1,629	100.0
US 1947-1939	**LP growth annual rate**	**VA 1939**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Leather and rubber and apparel	5.1	2,371	9.9	1,163	23.4
Textiles	5.1	1,822	17.5	882	41.2
Metals	2.9	8,543	53.1	2,182	85.1
Non metallic minerals	2.8	911	56.9	224	89.6
Tobacco	2.7	350	58.3	82	91.3
Paper and printing	2.3	2,636	69.3	528	101.9
Chemicals	1.7	2,555	80.0	357	109.1
Wood and furniture	- 0.7	1,245	85.2	- 68	107.7
Food and beverages	- 1.4	3,556	100.0	- 383	100.0
US 1947-1957	**LP growth annual rate**	**VA 1947**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Chemicals	6.5	7,308	10.3	6,410	26.9
Tobacco	4.1	641	11.2	320	28.2
Textiles	3.9	5,323	18.6	2,494	38.6
Non metallic minerals	3.3	2,299	21.9	877	42.3
Metals	2.7	28,189	61.5	8,650	78.6
Paper and printing	2.1	7,162	71.5	1,657	85.5
Leather and rubber and apparel	2.1	7,273	81.8	1,675	92.5
Wood and furniture	2.0	3,866	87.2	845	96.1
Food and beverages	1.0	9,116	100.0	942	100.0
US 1957-1967	**LP growth annual rate**	**VA 1957**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Chemicals	7.0	15,622	11.1	15,066	23.2
Textiles	5.2	5,197	14.8	3,419	28.4
Wood and furniture	4.2	5,799	19.0	2,979	33.0
Tobacco	4.1	1,246	19.9	621	34.0
Food and beverages	3.7	16,347	31.5	7,208	45.1
Metals	3.4	66,954	79.3	26,685	86.1
Paper and printing	3.1	13,637	89.0	4,920	93.7
Leather and rubber and apparel	2.7	10,421	96.4	3,155	98.5
Non metallic minerals	1.8	4,980	100.0	951	100.0
US 1967-1977	**LP growth annual rate**	**VA 1967**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Chemicals	5.6	28,976	11.8	21,133	22.3
Textiles	3.7	8,153	22.7	11,738	34.6
Metals	3.5	118,518	26.0	3,365	38.2
Leather and rubber and apparel	3.5	19,491	33.9	7,871	46.5
Food and beverages	3.0	26,621	34.8	712	47.2
Tobacco	2.9	2,032	83.1	39,733	89.1
Non metallic minerals	2.8	8,333	86.4	2,599	91.8
Paper and printing	2.5	24,111	96.3	6,757	98.9
Wood and furniture	1.0	9,143	100.0	1,002	100.0
US 1977-1985	**LP growth annual rate**	**VA 1977**	**Cum relative VA share**	**RCR**	**Cum intensive growth cont**
Metals	4.5	264,960	47.6	111,835	63.7
Textiles	4.1	16,105	50.5	6,134	67.2
Leather and rubber and apparel	3.8	43,130	58.3	15,002	75.7
Food and beverages	3.1	56,062	68.4	15,301	84.4
Tobacco	2.7	4,334	69.2	1,009	85.0
Wood and furniture	2.2	25,140	73.7	4,864	87.8
Non metallic minerals	2.1	19,130	77.1	3,389	89.7
Chemicals	1.8	73,099	90.3	11,217	96.1
Paper and printing	1.5	54,151	100.0	6,852	100.0

Sources: own estimates based on industrial censuses, and Bakker et al (2015).

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