Differences in Brazilian structural change before and after 1980: an exploration of its causes

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Abstract

Purpose – In this paper we investigate why the process of structural change in Brazil was growth accelerating before 1980 and why it was growth reducing after this year.
Design/methodology/approach – We investigate the causes of this change in behavior using the shift-share decomposition method.
Findings – The results indicate that in the first period there were high productivity gains as result of improvement in economic fundamentals such as the quality of capital and of labor and innovations. In this way, reallocation of workers between sectors, that is part of the process of structural change, was an inducer of economic growth. However, after 1980, mainly between 1991 and 2011, sectors that achieved productivity gains did so by reducing labor, which was absorbed by sectors with poor performance in terms of productivity growth. Furthermore, factors such as the deindustrialization that developed countries have been undergoing, the international situation, the stage of Brazilian economic development and its possible premature deindustrialization contributed to a growth reducing structural change.
Originality/value – Our differential to the matter is applying the shift-share methodology without combining any of the ten sectors analyzed, adopting a slightly different time frame than similar studies and presenting the shift-share results in a graphically manner in addition to the traditional numbers. By representing graphically how much each of the ten sectors is contributing to the structural change in the economy we are emphasizing the specificities of each of these sectors instead of just considering the aggregated view like manufacturing industry versus other industries or modern services versus traditional services.

Keywords Structural change, Labor productivity, Economic development, Deindustrialization, Shift-share
Paper type Research paper

1. Introduction

Brazilian economic performance has been precarious in the last three decades when measured by its GDP and labor productivity growth. After the country's redemocratization and the achievement of some macroeconomic stability, mainly through the Real Plan, it was expected that Brazil would resume a catching up trajectory in relation to the developed economies, as occurred between 1950 and 1980. However, with GDP and labor productivity growth rates since 1990 far from the past ones, it was not possible to achieve the growth speed necessary to fulfill those expectations.

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One way of investigating economic development is through the process of structural change in a country, as stated by Lewis (1954) and Kuznets (1966). In this process, labor moves to sectors with higher productivity, which are growing relatively more, causing changes in sector shares. Traditionally, structural change is associated with the transition from an agrarian economy to a more industrialized one. As the manufacturing industry sector grows in a country, workers are transferred from the countryside to the city to be employed in new factories, as they pay better wages as a result of generating greater added value and being more productive than the agricultural sector. However, the process of structural change does not only occur with the transfer of labor from rural to urban or from agriculture to industry. The main characteristic of this process is the displacement of workers from sectors with lower productivity to those with higher productivity. In this way, structural change never ends, despite having more pronounced phases, such as at the beginning of a country's industrialization.

Some studies have investigated this process in Brazil. Nassif, Morandi, Araújo, and Feijó (2020), Arend, Singh, and Bicharra (2016) and Firpo and Pieri (2016) reached the conclusion that the Brazilian structural change was growth-reducing from 1994 onwards. In other words, the reallocation of workers between sectors of the economy did not transfer labor from lower productivity activities to more efficient ones. This result differs with the structural change that occurred in Brazil during the period 1950–1980, as demonstrated by the same authors.

The purpose of this paper is to point out the reasons why the Brazilian structural change process developed in such a different way before and after 1980. To isolate the influence of the 1980s, known for being a period with very poor and atypical economic performance in Brazilian history, we adopted the time frame 1950–1980, 1981–1990 and 1991–2011 to investigate the differences. The focus of the explanation is on sectoral dynamics. Using the 10-Sector Database of the Groningen Growth and Development Center (GGDC10), which has information on added value and number of employed persons in Brazil from 1950 to 2011 grouped into ten economic sectors, it was possible to observe the annual labor productivity for each one of the ten sectors. Our differential from similar research is threefold. First, we apply the shift-share methodology without combining any of the ten sectors. Second, we make use of a more disaggregated form of this decomposition method (using three terms in the equation). And third, the time frame adopted is slightly different from similar studies. Possibly, the main contribution of the paper to the research topic is to present the shift-share results not just in numbers, but to graphically represent what is happening within the equation. The shift-share method is a mechanical decomposition of the productivity growth rate. By representing how much each of the ten sectors is contributing to the structural change in the economy we are emphasizing the specificities of each of these sectors instead of just considering the aggregated view like manufacturing industry versus other industries or modern services versus traditional services, for example.

It is usual to group sectors according to the division of agriculture, industry and services. However, to consider services as being homogeneous can be a mistake. There are some types that can be considered stagnant, such as commerce, as they have low potential for innovation and little probability of generating labor productivity gains. On the other hand, some types of services, such as information and communication technology, have a high potential for innovation and productivity gains, and some may also have significant spillover effects. This dual logic of the services sector, sometimes represented by the designation of modern services and traditional services, is formalized in Baumol, Blackman, and Wolff (1985). Subsequently, Oulton (2001) demonstrated that in terms of productivity and its spillover to the rest of the economy, what matters is whether the service product is a final service or an intermediate one in the production chain.

One of the firsts to use the GGDC10 database and the shift-share analysis were Timmer and de Vries (2009). Their goal was to determine which of the components of the

decomposition, the within effect or the between effect, was more important in explaining growth accelerations in developing countries in Latin America and Asia. Using data from 19 countries and aggregating them into 5 economic sectors [1], they concluded that growth accelerations are better explained by productivity gains within sectors than by the reallocation of workers between them. McMillan, Rodrik, and Verduzco-Gallo (2014) used the GGDC10 to study the patterns of structural change in a series of countries and regions [2] from 1990 to 2005. The authors investigated what were the determinants that caused a country or region to present a structural change that was growth-reducing or growth-accelerating by grouping the data into 9 economic sectors [3]. Their results indicate that countries with a comparative advantage in natural resources are at risk of undergoing a process of structural change that does not help economic growth.

In terms of studies that used the GGDC10 to investigate exclusively Brazil, stands out the paper by Nassif *et al.* (2020). The authors used the shift-share decomposition methodology to highlight the changes in behavior of the within effect and the between effect and identified the macroeconomic determinants of these changes. Their time-frames are slightly different from ours, namely 1950–1979, 1980–1994 and 1995–2011, and they divided the ten sectors into five groups [4]. Their results puts the between effect as the most important in explaining productivity growth rates between 1950 and 1979 and that factors such as the overvaluation of the exchange rate, the high concentration of primary products in the export basket, the low degree of economic openness and a high interest rate would explain why the Brazilian structural change was growth-reducing between 1995 and 2011. Our results are similar to those of Nassif *et al.* (2020) in terms of the importance of the structural change and the between effect for productivity gains in the period 1950–1980, however, we highlight that the main difference before and after 1980 is the behavior of the within effect, which is linked to economic fundamentals as stated by Rodrik, McMillan, and Sepúlveda (2016).

Finally, the main causes of the negative contribution of the structural change to economic growth and the low performance of Brazilian labor productivity are discussed. According to the literature, the stages of economic development, deindustrialization and its possibly prematurity in Brazil in addition with a lack of coordination of an industrial policy may be responsible for such performance, as attested by Rowthorn and Ramaswamy (1999), Rodrik (2015), Tregenna and Andreoni, (2020) and Araujo, Araújo, Peres, and Punzo (2021).

In section 2 of this paper we present a literature review on structural change and cite some important references in the debate on deindustrialization and premature deindustrialization. In section 3 there is a brief history of Brazilian structural change from 1950 to the present day. Afterward, in section 4, the database is explored and the shift-share decomposition method is used to shed light on the differences in sectoral dynamics when Brazilian structural change was a growth accelerator and what changed when it stopped being so. In section 5 we discusses the importance of a modern services sector to achieve sustainable growth in labor productivity in the most advanced stages of economic development and also the deindustrialization process that has been occurring throughout the world, but with greater emphasis on Latin American countries and what has been called their premature deindustrialization. In the last section final considerations are made.

2. The importance of structural change and its relation with deindustrialization

At its core, structural change means that some sectors experience faster growth rates than others, taking a long-term perspective. This phenomenon causes changes in the sectoral composition, or participation, of the aggregate economy and causes some sectors to gain importance over time, while others end up becoming supporting actors in the process of economic development. This movement is not constant and can vary between countries, but it defines the characteristics of an economy (Krüger, 2008). The two most common ways of

measuring sectoral participation in the aggregate economy would be via value added or by the number of workers employed.

Lewis (1954), in his seminal work, built a theory of economic growth whose centrality is in the structural change, inequality, wages and population. The key point of his theory is the duality that exists in underdeveloped economies between a modern sector, which the author named capitalist, and, therefore, with a greater objective of accumulation, and a traditional sector, whose focus would be subsistence. The coexistence of this duality would be made possible by the significant size of the subsistence sector, which would be capable of providing a huge number of workers for the capitalist sector, making its labor supply perfectly elastic at a fixed salary. Due to an abundant supply, wages would be determined in the traditional sector, and, in turn, would correspond to a level close to subsistence consumption. In other words, the supply of labor would not be a restriction for the capitalist sector. This situation would continue until the most developed and modern activities were able to absorb enough workers so that their supply is no longer perfectly elastic.

The economic duality brought by Lewis (1954) does not exactly make the distinction between these two sectors clear, as Gollin (2014) points out. However, many authors identify industry or urban with the modern and capitalist sector, while linking agriculture or rural with traditional and subsistence, even though this is not the definition used by Lewis. However, Lewis himself will state, at a later point, that the notions of industry versus agriculture, or rural versus urban, could be approximations of his ideas [5].

In Lewis's growth theory, the primary difference between capitalist and subsistence activities would be their productivity, since the two sectors operate with very similar wages. While in the first the presence of capital makes it highly productive, at least in relation to the other sector, even if not necessarily productive enough to compete abroad; in the second, the low productivity is a result from the lack of capital for investments. This disparity in structure would be overcome as the accumulation of capital from the more developed activities makes it possible to absorb excess workers from the lagged sector. Therefore, Lewis's growth model offers a description of the process of economic development that places structural change at the center of the debate, i.e. his main theme is the reallocation of labor and other resources between sectors that an economy goes through on its path towards greater GDP per capita and better social conditions. Lewis was a defender of the industrialization of low-income economies and recommended public policies that supported this path as Weiss (2018) attests.

Rodrik *et al.* (2016) bring a unique insight into how the Lewis model fits into the field of economic growth theories. For these authors, there are two traditions to explain and investigate economic growth; a first based on Lewis (1954), and a second based on Solow's (1956) neoclassical growth model. In dual economy models, output growth depends on the transformation of farmers into industrial and urban workers, where productivity is on an upward trend. In this approach, the challenge for economies is to ensure a rapid transition of resources from traditional to modern sectors. Therefore, it is a view that is concerned with the relationship between sectors. On the other hand, in the neoclassical world, the key to growth lies in accumulating capital (physical and human), knowledge and institutional quality capable of generating sustained productivity growth in all sectors. Differences between sectors do not matter and the theory adopts the idea that the economy can be aggregated into a representative sector. In this modeling, growth depends on the accumulation of physical and human capital, the savings rate and the advancement of technology. Thus, this interpretation of the growth process focuses its analysis on what occurs within sectors, that is, it could be said that it is more concerned with economic fundamentals.

An excellent summary of the literature on structural change is provided by Krüger (2008). He divides research on the topic into four theories: the first called the three-sector hypothesis, which deals with the pattern of change between agriculture, manufacturing and services; the

neoclassical multi sectoral growth models; theories of structural change from the evolutionary tradition; and empirical studies of reallocation and its relationship to uneven productivity growth. This article fits into the last mentioned trend. In the next paragraphs we briefly expose the logic and the main aspects of each of these four lines of theory on the topic of structural change.

The three-sector hypothesis is probably the best known and most debated. Its cornerstone is the work of Kuznets (1957) and his postulates state that in the beginning of the development of an economy the primary sector, composed of agriculture and related activities, is the one that employs the most and that produces the most added value in the economy. As the economy grows, the secondary sector, normally characterized by the manufacturing industry plus construction, begins to gain relevance with the industrialization of a country and absorbs workers and starts to generate greater added value than the primary sector, while the tertiary sector remains stagnant. However, at a later point, workers and production migrate to the tertiary sector, which is made up of all types of services, and then it becomes the main activity of the country's economy in terms of job creation and of value. This pattern is true for all major economies in the world. The best theoretical explanation for the emergence of this development pattern is given by Fourastié (1969, apud Krüger, 2008). In this sense, the author assumes different labor productivity growth rates for each of the three sectors, which, in a competitive market, would lead to different price trends between the three. Thus, with increases in labor productivity, the real cost of labor falls, allowing price reductions. In the long term, technological progress decreases rents and profits in all sectors, but with different magnitudes. Since, in Fourastié's theory, it is these two that determine the speed and direction of structural change, the relative price structure, through its effect on rents and profits, is what determines the allocation of factors of production between sectors.

Neoclassical multisector growth models can also be used to analyze structural change. However, most of these models use premises that make them of little use for this type of study. Two examples are the models based on Solow (1956), which consider technological progress as exogenous, and those inserted in the Schumpeterian growth theory school of thought, such as the seminal work by Aghion and Howitt (1992), which, despite being a multisectoral model, considers that all sectors are symmetrical. As so, they assume equal growth rates in the long term, therefore making any study of structural change impossible. The class of multisectoral models with a neoclassical foundation that allows capital and labor mobility between sectors are represented by the work of Acemoglu and Guerrieri (2006). For these authors, as capital deepening occurs, the relative product of the sector with the highest proportion of capital increases, concomitantly with the reallocation of capital and labor to other sectors. This result is obtained by assuming different proportions of factors between sectors and without imposing non-homothetic preferences. Therefore, the model provides a supply-side explanation of structural change à la Baumol (1967).

Another school that makes important contributions to studies of structural change is the one which makes use of the theoretical framework of evolutionary economics. These authors perceive economic development as cumulative and subject to historical contingencies (path dependence) in which economic agents are heterogeneous and have limited rationality in the face of high uncertainty scenarios that do not allow the assignment of probabilities to possible events. Pasinetti (1981, 1993) is the main author of this school of thought when it comes to structural change. His theory considers that the "natural" forces of structural change are population growth, learning in the production process and the diversification of consumption. These vectors would lead to different rates of productivity growth, new product development and changes in consumer behavior. Learning, especially, is responsible for two effects on the production process: first, learning provides growth in labor productivity and changes the structure of relative prices; second, product innovations are what enable new industries to emerge. Regarding consumption, it shapes the process of structural change by

presenting different growth rates between sectors. In the end, Pasinetti's model becomes quite complex and mixes formal elements with appreciative arguments and an analysis that shifts between normative and positive issues. As a result, his model does not allow it to be tested empirically.

The fourth and final stream of studies on structural change deals with empirical research on reallocation. Based on Fabricant's (1942) decomposition method, the authors seek to understand the different rates of productivity growth between sectors by separating the variations into components, usually one that measures the variation within sectors and another that sums up the differences between sectors. In this way, economic growth is perceived as a reallocation of resources, capital and work, between sectors with different productivity and on different trajectories. Among their examples, we can mention Foster, Haltiwanger, and Krizan (1998), Bartelsman and Doms (2000) and Haltiwanger (2000). This study fits into this line and seeks to analyze the differences in the behavior of Brazilian structural change before and after 1980 without imposing a theoretical basis (neoclassical or evolutionary) in the background.

Regarding deindustrialization, this is a topic that has been widely debated in recent decades. The definition of its concept is still not exactly a consensus, the same is true for the idea of premature deindustrialization, which would mainly impact countries in Latin America and Africa. One of the first articles to investigate the issue related to developed countries was Rowthorn and Ramaswamy (1997). Considering deindustrialization as the relative loss of the manufacturing industry's share in total employment, they concluded that the phenomenon would not be as negative as cenarios of growing inequality and unemployment, but a natural consequence of the process of economic development in advanced economies in which manufacturing productivity grows faster than in services. Later, in Rowthorn and Ramaswamy (1999), econometric tests showed that deindustrialization could be explained by internal factors in developed countries, such as the change in preference patterns between manufacturing and services, the faster growth in productivity in the former and the fall in relative prices of manufactured products. Rowthorn and Coutts (2004), in turn, investigated the relationship between the balance of payments and deindustrialization (observing the behavior of the USA and the United Kingdom) and showed that, in the United Kingdom, the stability of the balance of payments remained due to growth in exports of knowledge-intensive services to offset the decline in manufacturing exports. As the former sector employs fewer people, they estimated that 5 million jobs in the manufacturing industry were closed due to exports to the South (in a synonym for developing countries, while the North would be developed countries), since countries of the South would have advantages in the production of labor-intensive goods. Finally, they argue that manufacturing still matters for the economic performance of developed countries and that recent evidence of premature deindustrialization in Latin America would be a growing concern for policy makers in the region.

The most common interpretation is that deindustrialization is a natural result of the economic development process, according to Rowthorn and Ramaswamy (1999) and Araujo *et al.* (2021). In this sense, in the initial stages of development, the income elasticity of demand for manufacturing is greater than 1, while in more advanced stages this elasticity would become less than 1. This fact is representative of a change in the composition of demand in favor of services. This occurs due to changes in the relative prices of manufactured goods, which, during the course of development, fall due to their greater relative growth in labor productivity. However, at more advanced stages of development, the substitution effect in favor of services would come into play. The final product in terms of employment and industrial production would depend on the response of demand in relation to the declining prices of industrial goods, that is, its increase would need to compensate for the fall in prices so that its share in the aggregate remains constant. In developed countries, it is expected that

the increase in demand will not be able to overcome the drop in prices. However, in developing countries this is unlikely to be the case, as they are at earlier stages of development, demand for manufactured goods would tend to be stimulated in view of their demand elasticities and the greater productivity of the industrial sector (Araujo *et al.*, 2021).

A good summary of the main sources of deindustrialization, whether in advanced or developing countries, is the work of Palma (2005). The author used data from 105 countries from 1960 to 1998 to define four causes of global deindustrialization. The first source of deindustrialization is the inverted-U relationship between manufacturing employment and per capita income. As a country's per capita income grows, the share of manufacturing employment in the overall economy increases. However, after a certain income level this participation starts to decrease. This movement has historically been associated with the transition of rural workers to industry, causing the relative share of employment in this sector to increase and then with the transformation of more developed economies into service economies, in which this sector becomes the largest employer and the one that contributes the most for GDP. Therefore, there would be a per capita income value at which a country would be driven by the expansion of the services sector and the manufacturing industry would lose relative importance. When estimating this inverted U relationship for several decades, 1960–70–80–90, Palma (2005) found that the slope of the curve has been falling, which would be the second source of deindustrialization, and that the maximum point has been moving to the left, which would be the third factor of deindustrialization. Taken together, these three factors indicate that countries have begun their process of relative reduction in manufacturing employment at increasingly lower levels of per capita income. The fourth source would be the Dutch Disease, for which Palma presents a new concept that is more comprehensive than the previous one.

However, a new typology on deindustrialization processes emerged from Tregenna's (2009) research. Considering only manufacturing employment to assess deindustrialization is not accurate, says the author, as a drop in employment of the same magnitude has different meaning for an economy depending on what is happening with the share of manufacturing industry in GDP. For example, a drop in employment together with an increase in manufactured goods in GDP means an increase in productivity in this sector, while the same movement in employment, but with a drop in relative participation in GDP, indicates a clear deindustrialization. Thus, a typology of eight forms of changes in manufacturing is laid off, the fall or increase in employment can be combined with four product behaviors: growth in absolute values of the product with an increase or fall in its relative participation in GDP and fall in absolute value of the manufacturing product with an increase or decrease in its relative participation in GDP. Countries such as Finland, South Korea and Ireland fit into the group that saw a drop in employment, but with growth in absolute and relative manufacturing output. Most countries are in the group with a decline in employment and relative participation in GDP, but with product growth in absolute terms. Brazil was not included in the sample due to problems with its data. By way of comparison, Chile is in the same group as most countries, but Argentina and Uruguay are classified together as those that saw a drop in the three indicators evaluated, a very bad result, therefore.

Finally, we highlight that the manufacturing industry is essential for development according to the Kaldorian view of the economy. According to this school of thought, this sector has properties that cause positive externalities in the economy that other sectors are not capable of replicating. Prebisch, Kalecki, Hirschman, Furtado, among other economists, are disciples of the Kaldorian line. They contrast with neoclassical growth theories, based on Solow, which consider that sectors are neutral in the growth trajectory, or with endogenous growth theories, based on Romer, which consider that some activities, such as research and development, can play a prominent role in innovation.

3. The Brazilian structural change – 1950–2011

To study Brazilian structural change, we made use of data from the GGDC 10-Sector Database (GGDC10) (Timmer, de Vries, & de Vries, 2015). This database contains the value added in reais, at 2005 constant prices, and the number of employed persons in 10 economic sectors. The historical series starts in 1950 and goes until 2011. Table 1 shows which activities are contained within each of the ten sectors and their correspondence with the International Standard Industrial Classification (ISIC Rev. 3.1) [6].

The nomenclature of the first five sectors does not require further clarification, with the possible exception of remembering that the Agriculture sector covers more than its name indicates, but which the table itself clarifies. On the other hand, in relation to the five Services sectors, their designations are quite summarized when compared with the diversity of activities that each one encompasses. The Transport, Storage and Communications Services sector (from now on, Transport Services), for example, comprises the activities of travel agencies and not only postal communications but also telecommunications. Finance, Insurance, Real Estate and Business Services (from now on, Business Services) are quite broad and encompass insurance, reinsurance, social security, rental of machinery and equipment, computing-related services (hardware, software and data processing), as well as maintenance and repair, all types of research and development (related to natural sciences, engineering or social sciences) in addition to all services from accountants, lawyers, marketers, architects, etc. whether for companies or individuals. Government Services are not all carried out by the State (despite the name suggesting otherwise), especially in the area of education. Community, Social and Personal Services (from now on, Personal Services), in turn, include trade unions, religious and political organizations and recreational, cultural and sporting areas, including radio and television, as well as goods and services produced for personal use, domestic services, funeral services and beauty salons. In Table 1, the emphasis on the inclusion of sewage and waste management in Personal Services is due to the fact that in the National Classification of Economic Activities (CNAE 2.0) these activities are part of the water supply and, therefore, of the Utilities sector.

Table 1.
List of sectors, economic activities and ISIC code of GGDC10

Sector	Description of activities	ISIC 3.1 code
Agriculture	Agriculture, livestock, forestry, fishing and aquaculture	A + B
Mining	Mining and extraction	C
Manufacturing	Manufacturing industry	D
Utilities	Electricity, gas and water	E
Construction	Construction	F
Trade, restaurants and hotels	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; hotels and restaurants	G + H
Transport, storage and communications	Transport, storage and communication	I
Finance, insurance, real estate and business services	Financial intermediation, real estate services, rentals, business activities and research and development	J + K
Government services	Public administration and defense, education, health and social services	L + M + N
Community, social and personal services	Personal and domestic, social and community service activities, including sewage and waste management	O + P

Note(s): Elaborated with information from GGDC, ISIC Rev. 3.1 and CNAE 2.0
Source(s): Table by authors

It is important to observe the relative share of added value and employed persons in each sector over time to understand Brazilian structural change. The participation of the Manufacturing Industry in the economy's total added value, for example, starts at 18.4% in 1950, reaches its peak in 1973–74 with 23% and ends with a 17.6% share in 2011. This fact denotes the loss of relative importance of this sector, i.e. a movement of deindustrialization, mainly from the mid-1970s until 2011. The participation of the other three sectors considered industry, Utilities, Construction and Mining, grew slowly during the period, going from 10.4% to 12.9% of total value added. All Services combined, in turn, had a 58% share in 1950 and reached 63.2% in 2011, showing slight growth. In other words, this sector was already the largest since 1950 for the country, a characteristic shared with the Latin American region, as Szirmai (2012) and Szirmai and Verspagen (2015) have already demonstrated. Finally, Agriculture presents two moments: a first of decline, starting from 13.3% of value added in 1950 until reaching 4.4% in 1986; and a second of recovery, which continues until the end of the series, when it reaches 6.3%. These trajectories can be observed in Figure 1, which illustrates a loss of importance of the Agriculture and Manufacturing sectors to the detriment of the Services sector. However, in general terms, it can also be stated that the value-added economic structure of the Brazilian economy presents relative stability during the 61 years under analysis, that is, there are no significant changes or ruptures.

Analyzing the data of employed personnel leads to different conclusions that we get from observing the historical trajectory of sectoral added values. As can be seen in Figure 2 it is clear that there is no stability in the structure between sectors; Agriculture, for example, had a relative share of 64.4% of total employees in 1950 and ended the series with 16% in 2011. The sectors that absorb its workforce are Services (the five subtypes) and Construction. In the initial year, the five services together accounted for 19.1% of employment and Construction for 3.6%. In the end, these numbers were, respectively, 63.7% and 7.9%. Therefore, substantial changes occurred between Agriculture and Services. Meanwhile, the

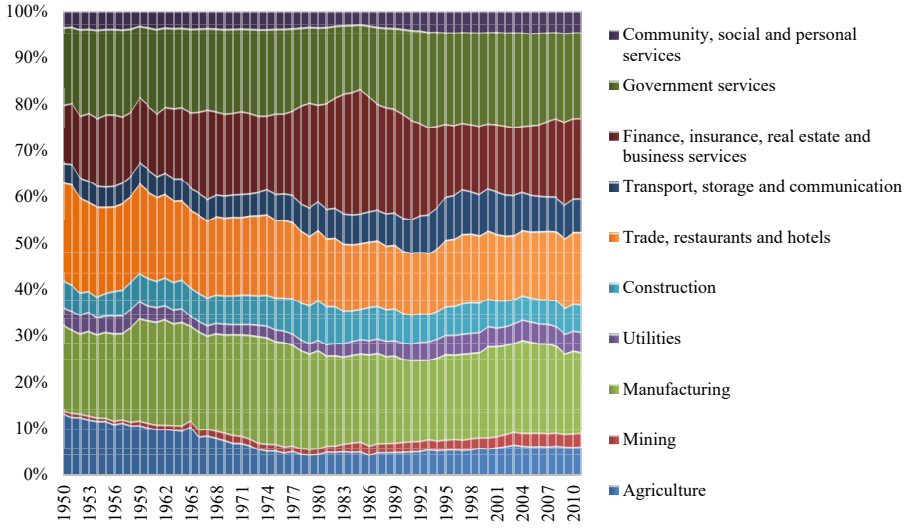


Figure 1.
Share of sectoral value added in total value added in Brazil per year, 1950–2011

Note(s): Data from GGDC10. Fixed prices from 2005. Agriculture is the 1st sector from bottom to top, Mining the 2nd and so on. The colors of the sectors are the same on all figures
Source(s): Figure by authors

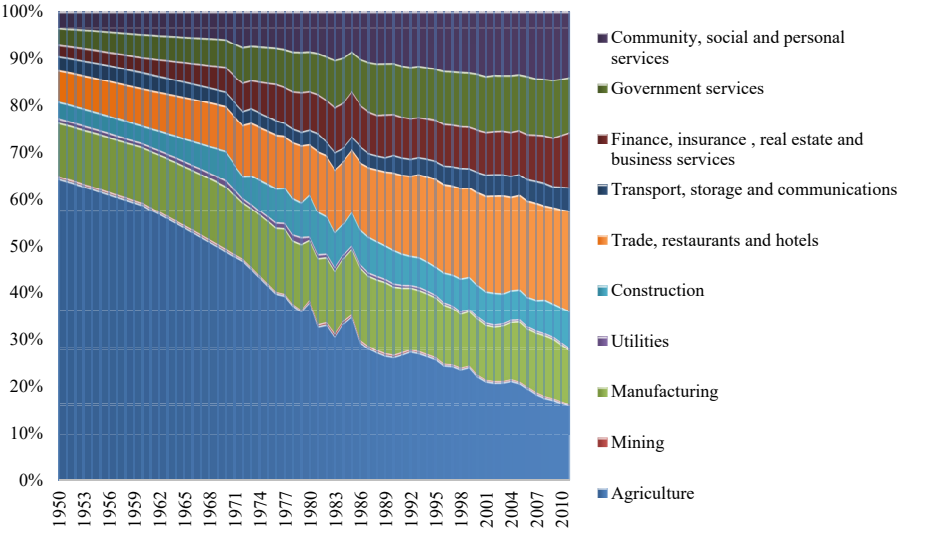


Figure 2.
Share of sectoral employment in total employment in Brazil per year, 1950–2011

Note(s): Data from GGDC10
Source(s): Figure by authors

Manufacturing Industry had 11.5% of employed people, reaching its peak in 1986 with 15.4%, but ended the series at the same point at which it began, with a relative share of 11.5%. Despite being a key sector for Brazilian industrialization, Manufacturing never reached the share of total jobs that advanced economies achieved. According to Araujo *et al.* (2021), in 1970, Germany, the United Kingdom and the United States of America had, respectively, 39.5%, 34.7% and 22.2% of their workforce working in manufacturing. In other Latin American countries, such as Argentina, Chile and Mexico, the peak of this participation was 24.7%, 20.7% and 19.9%, respectively, despite having been reached in different years. These numbers are consistent with those found in Palma (2005) and Rodrik (2015). Thus, the data shows that, when compared to other countries, in Brazil the manufacturing industry was less important in terms of job creation. The last two sectors, Utilities and Mining, are almost imperceptible in the graph, showing that they use very little labor (in relative terms).

Thus, it can be stated that Brazilian structural change was not led by the transformation of agricultural workers into industrial workers. This migration of labor occurred mainly until the mid-1980s. However, its intensity was relatively low, as is clear from the observation of Figures 1 and 2. The main demand for labor came from services, with emphasis on the Trade, Restaurants and Hotels Services (from now on, Trade Services), which is the largest employer of people in 2011 [7].

With the data of added value and the employed personnel in hand, the next step is to observe the sectoral labor productivity by dividing these two variables. Table 2 shows the evolution of labor productivity in each sector, presenting its results at the beginning of each decade. It can be seen that only three sectors follow an uninterrupted growth trend: Agriculture, Mining and Utilities. The other seven sectors showed productivity growth between 1950 and 1980; but, in 1990, these activities suffered a fall of 20% to 50% of their previous performance (depending on the sector), reducing their efficiency. In the years 2000 and 2011, there was a recovery in these seven sectors. However, at the end of the historical series, they did not reach the level of labor productivity they had in 1980. This result

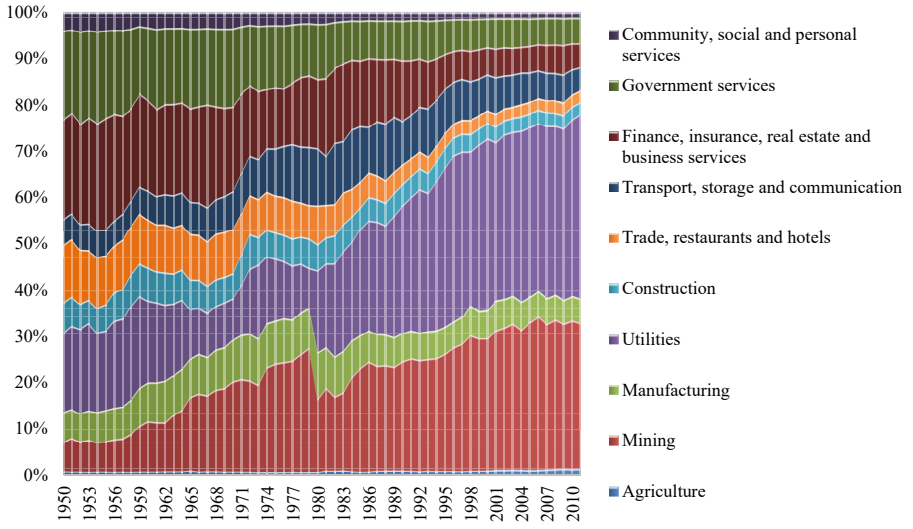
	1950	1960	1970	1980	1990	2000	2011
Agriculture	1.2	1.5	1.9	2.6	3.4	4.9	8.0
Mining	9.1	21.1	47.7	57.1	82.3	141.3	184.2
Manufacturing	9.3	16.3	21.9	36.4	21.7	30.6	31.1
Utilities	24.7	34.5	22.0	64.9	96.8	183.6	234.3
Construction	9.4	13.9	13.5	20.6	16.0	16.8	15.0
Trade, restaurants and hotels	18.1	20.4	23.6	30.7	14.5	13.7	15.0
Transport, storage and communications	8.3	12.2	20.0	44.7	33.2	38.5	29.4
Finance, insurance, real estate and business services	31.2	38.0	45.0	54.8	45.9	29.3	30.3
Government services	27.7	30.8	41.4	43.4	29.9	30.6	31.9
Community, social and personal services	5.7	6.3	8.4	8.8	6.1	6.3	6.6
Total	5.8	8.8	13.3	21.9	17.8	18.6	20.4

Note(s): Data from GGDC10
Source(s): Table by authors

Table 2.
Sectoral labor productivity in Brazil, selected years (R$ 1,000)

highlights the economic stagnation and slow recovery in Brazil after 1980, as well as being indicative of a process of falling behind in relation to other growing economies (this falling behind will not happen only if other countries are growing even less).

Another way to visualize this evolution of the sectoral labor productivity is to observe its result relative to the total economy. Figure 3 shows how the Mining and Utilities sectors gained relative importance to the point that, in 2011, the two alone had a combined percentage greater than 50% of the total economy. Furthermore, the decline in productivity of the services sector as a whole and also of the Construction sector is evident. The Manufacturing Industry, in turn, manages to maintain considerable stability in its participation throughout the entire series. Finally, Agriculture, despite showing an upward trend during the 61 years analyzed, presents a relative labor productivity that is practically imperceptible due to its low added value when compared to other sectors.



Note(s): Data from GGDC10
Source(s): Figure by authors

Figure 3.
Participation of sectoral labor productivity in total labor productivity in Brazil per year, 1950–2011

Based on this scenario, then, what would be the best dynamics for the displacement of workers? The ideal would be for the workforce to move to the sectors that are most notable for productivity growth. However, as seen in Figure 2, the Mining and Utilities, whose productivity performance is superior to the others, are activities that use a relatively stable number of employees. Furthermore, historically, in Brazil, the sectors that absorbed the most workers were Services and Construction, which are precisely those that lose relative participation in labor productivity. This situation had already occurred since the beginning of the series in 1950, but worsened at the end of the 1970s, as can be seen in Figure 3.

There is no ideal type of structural change, as long as the shift of labor occurs towards sectors that are experiencing productivity gains. Therefore, the transition of workers from Agriculture to Services does not pose a problem. This fact, together with the high labor productivity of the Mining and Utilities sectors, constitute characteristics specific to the Brazilian process of structural change. In order to deepen this characterization, the next section investigates how sectoral productivity growth occurred.

4. Decomposition of the labor productivity growth rate

We can now apply the shift-share decomposition methodology to the sectoral productivities to determine whether the performance was a result of internal gains in the sectors or was due to structural change. The seminal research on this method is that of Fabricant (1942). The author divided productivity growth into an internal component, the within effect, and a reallocation component, the between effect. The internal component indicates how much of the productivity growth came from increases in efficiency within sectors and can be associated with economies of scale, innovations, improvements in the quality of capital and labor, as well as efficiency gains resulting from improvements in the institutional environment. The reallocation component, in turn, points out how much of productivity growth can be explained by the movement of workers from less productive sectors to more productive ones and, for this reason, is associated with the process of structural change.

A more up to date version of the method can be found in van Ark (1997) and Timmer and Szirmai (2000), which translates into Equation (1) below:

$$\frac{\Delta P_t}{P_{t-k}} = \frac{\Sigma_i \, \Delta P_{i,t} \, S_{i,t-k}}{P_{t-k}} + \frac{\Sigma_i \, P_{i,t-k} \, \Delta S_{i,t}}{P_{t-k}} + \frac{\Sigma_i \, \Delta P_{i,t} \, \Delta S_{i,t}}{P_{t-k}} \tag{1}$$

Thus, the variation in labor productivity over time, divided by labor productivity over time, that is, its growth rate, can be seen as the sum of three terms (all expressed as variations in relation to past productivity, indicated by the same denominator in all three). The first term multiplies the variations in labor productivity in each sector, over time, by the share of employment in each sector in total employment in the economy relative to the previous period. Therefore, it denotes an intra sectoral effect, or a within effect, that weighs current productivity variations by the economic structure of the past. The second term on the right side of Equation (1) does the opposite and measures current structural changes, and weights them by previous sectoral productivity. Finally, the third term captures the present joint variations between productivity and employment across sectors.

de Vries *et al.* (2015) call the second and third terms static between effect and dynamic between effect, respectively. According to the authors, this distinction allows one to determine whether the movement of workers occurs to sectors with positive or negative productivity growth. Rodrik *et al.* (2016) criticize this definition as such nomenclature would be confusing, given that structural change, by definition, is a dynamic process. Furthermore, when observed in isolation the third term would be difficult to interpret. For these reasons, as the third term is partly structural change and partly productivity variation, and to avoid

going into the discussion of its economic interpretation [8], we chose to call it by its formal functional form, therefore, a covariance effect. There are other forms of shift-share decomposition used in the literature. However, the one described in Equation (1) is the only one that does not adopt the hypothesis of orthogonality between structure and productivity imposed by the method (Jacinto & Ribeiro, 2015) [9].

The shift-share decomposition method can be used at any time interval. For the purposes of the investigation in this article five distinct periods were used. A first one comprehending the complete time series, from 1950 to 2011. Then, dividing it between the period of growth by import substitution, from 1950 to 1980 (Fonseca, 2003), and a second moment after the second world oil crisis, between 1981 and 2011. This division also coincides with the peak of labor productivity in several sectors, as seen in Table 2. Finally, the second period was divided into two, 1981–1990 and 1991–2011, with the intention of isolating the consequences of the acute crisis experienced by Brazil in the 1980s, often referred to as the lost decade, and to capture the recovery effects experienced with the redemocratization and economic opening of the early 1990s.

The results are shown in Table 3 and demonstrate large differences in the analyzed years. For the entire period there was a productivity gain of 250.6%, with the within effect contributing 178% to this result and the between effect contributing 142.5%. The growth was not greater because the covariance effect contributed negatively with −69.9%, reducing the gains for the period. When comparing years before and after 1980, the difference is extreme. The within effect was negative from 1981 to 2011, while in the first three decades of the series it was 140.5%. The same occurs with the covariance effect, although to a smaller magnitude. The between effect has the smallest difference in the two time intervals, both being positive; even so, in the first decades it is almost four times greater than in later years. Regarding the differences of the lost decade of 1980 and the recovery since 1991, the results indicate considerable dissimilarity among the periods, with the interval 1981–1990 presenting the worst results of the within and between effects among all. Finally, it is noted that labor productivity growth was much higher before 1980, reaching a cumulative value of 275.2%, than after, when it increased by a measly 0.3%.

Furthermore, it is clear that the within effect oscillates more than the other two effects, indicating that it is more susceptible to general economic performance, that is, when there is growth it appears positive, while in times of recession and depression it becomes negative. The between effect, in turn, always remains in the positive field, showing some resilience, despite varying considerably in magnitude. The covariance effect is indeed difficult to interpret, as the literature indicates. Its result is quite negative for the entire period and quite positive for the interval 1950–1980. However, between 1981 and 2011 it is negative, but in magnitude is less than a third of the total period. In general terms, it appears to follow the economic trend.

In economic terms, the results indicate that the development process requires both improvements in the economic fundamentals linked to the quality of labor, capital and institutions, variables represented by the within effect, and rapid and significant structural

Period	Within effect (%)	Between effect (%)	Covariance effect (%)	Total (%)
1950–2011	178.0	142.5	−69.9	250.6
1950–1980	140.5	77.0	57.7	275.2
1981–2011	−1.2	19.5	−18.0	0.3
1981–1990	−16.9	7.1	−3.1	−12.8
1991–2011	13.6	10.4	−8.9	15.1

Source(s): Table by authors

Table 3. Shift-share decomposition of the labor productivity growth rate in Brazil, selected periods

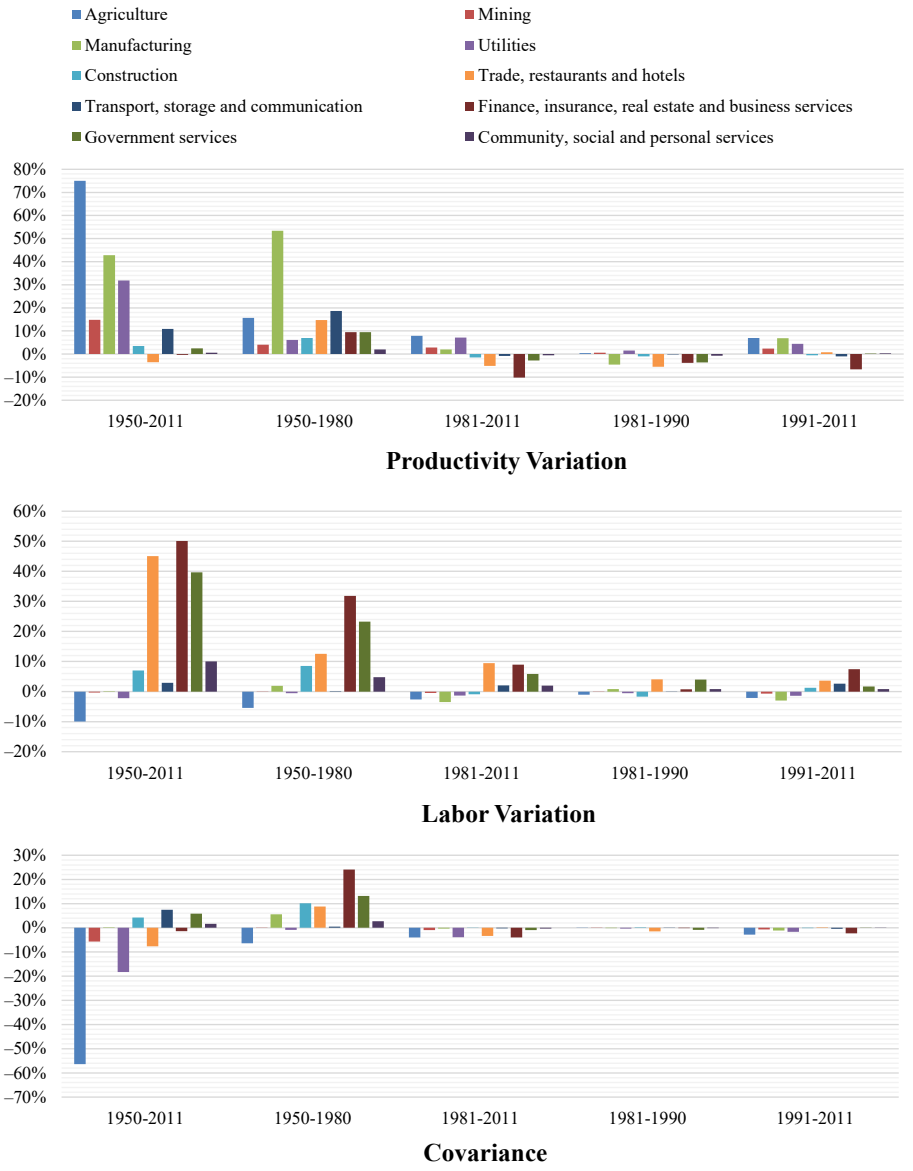
change, represented by the between effect. In Brazil, it was this combination that made possible the catching up process experienced between 1950 and 1980. This combination of elements even occurred again in the country between 1991 and 2011, however, as can be seen in Table 3, due to the timid growth in productivity in the period, the magnitude of the effects represents less than a tenth of that experienced before 1980. Furthermore, the findings show the importance of structural change as a stabilizing effect on the economy, since it is always positive, regardless of the adverse macroeconomic conditions in the country, such as those from 1981 to 1990. This resilience compensates for fluctuations in the within effect, which, as it is linked to economic fundamentals, suffers greatly from the ups and downs of the economy as a whole.

The results found are similar to those of Nassif *et al.* (2020), but they have some important differences, mainly related to the first time interval. For them, in this period, the between effect was slightly greater than the within effect, the opposite of what was found in our Table 3. However, there are subtle differences that may be the cause of the discrepancies, such as their use of a time interval of 1950 to 1979, the grouping of sectors of Agriculture and Mining, Construction and Utilities, and the division of services with high work skills (business and transport) from those with low work skills (trade, government and personal). Furthermore, the form of the shift-share decomposition used was that of McMillan and Rodrik (2011) and McMillan *et al.* (2014), which uses only two terms, without the covariance effect. By way of comparison, this designation of the method equation would be the equivalent of summing up the between and covariance effects from Table 3. This would mean that the structural change component for the period 1950–1980 would have a value of 134.7%. These methodological differences in time frame, sectoral grouping and modeling of the decomposition equation could be the reason for the slightly discrepant results [10].

The results in Table 3 are also considerably close to those of Firpo and Pieri (2016), who also decomposed the Brazilian labor productivity growth rate, but used the previous version of the Groningen Growth and Development Center database, which had nine sectors and ended in 2005. Furthermore, they made use of McMillan and Rodrik's (2011) methodological form of two terms in the equation and the effects were calculated for six different time intervals, two of which are similar to the ones used in this article, 1950–2005 and 1990–2005.

To further investigate what happens in the sectoral dynamics and with the aim of observing the individual contribution of each sector to each of the three effects, one can investigate what happens in Equation (1) before applying the sum to group the effects of each sector. Thus, observing the first term on the right side of Equation (1), for example, before applying the sum, it is possible to see the result of the variation in labor productivity in each sector multiplied by the relative share of employment in the previous period. This would be their individual contribution to the total within effect. This number cannot be called the within effect of the sector, as it is relativized according to the total productivity of the economy. In fact, looking at the results before applying the sum indicates its variation in labor productivity weighted by its share of employment in the initial year. The same reasoning can be extended to the second and third terms of Equation (1), resulting in the variation in employed personnel weighted by past productivity and the variation in covariance, respectively.

Figure 4 shows these variations for each sector divided into the same five time intervals as in Table 3. Its correct interpretation requires keeping in mind Equation (1) and the information contained in Figures 1 and 2. Observing Agriculture from 1950 to 2011, it can be seen that it is the sector that increased its productivity the most compared to the initial year, with a fall of 10% in the number of workers and a high negative variation in its covariance. Although its labor productivity is low, in added value, its final value in 2011 is almost 7 times greater than in 1950 (see Table 2). Furthermore, its high participation in employment in 1950 (Figure 1) helps explain its high variation in productivity because the within effect weights



Note(s): Data from GGDC10
Source(s): Figure by authors

Figure 4.
Sectoral contributions to the 3 effects of the shift-share decomposition for five-time intervals

sectoral productivity variations by its past structures, as shown in Equation (1). Similar logic can be applied to explain the variation in workers and the variation in covariance in Agriculture and other sectors. In this sense, the fall in agricultural workers is high between 1950 and 2011; however, its relative productivity is small in 1950, resulting in a negative

variation in workers, but not as large as expected. A substantial negative result shows up in the covariance variation, this is because we have a positive result in the variation in productivity between 1950 and 2011 multiplied by a negative result from the substantial variation in workers in the same period.

The combination of variations in productivity, workers and covariance in the Agriculture sector reveals its contribution to productivity growth during the 61 years of the series. As can be seen in Figure 4, the sector's productivity variation was close to 75%, while the sum of worker variations and covariance was negative at around 65%. Thus, its total contribution was approximately 10 percentage points of the 250.6% increase in labor productivity for the period. This result is in line with the characteristics of this sector and its trajectory of added value and employment represented in Figures 1 and 2. Agriculture is an activity with low added value, which, from 1950 to 2011, significantly increased its productivity and lost a lot of participation in the labor market, that is, its performance is based on efficiency gains and capital increases combined with a relative reduction in the use of labor. These characteristics are desirable for the aggregate economy, the only drawback, if it can be called that, is the fact that their impact on the total product is small, due to the low added value.

The logic detailed above for analyzing the Agriculture sector is the same for other sectors and time intervals. Therefore, comments will only be made for those facts of greater relevance.

For the period 1950–2011, Manufacturing and Utilities sectors, in addition to Agriculture, show the highest rates of productivity variation, while Trade, Business and Government Services are the most important in terms of worker variation. The variation in covariance is low, with the exception of the already discussed Agriculture and Utilities sectors. Therefore, analyzing the within, between and covariance effect of each sector, the sectors that stand out as most responsible for the aggregate labor productivity performance are the Manufacturing Industry, due to its productivity gains with relative stability in the number of employees, and Trade, Business and Government Services as the main demanders for labor. Mining and Utilities sectors are not among the main sectors to explain movements in aggregate labor productivity due to their relatively small participation in the structure of the Brazilian economy (Figure 2) [11].

Between 1950 and 1980, the sectors that contributed the most to aggregate performance were Manufacturing, Business and Government Services. It is noteworthy that in the period all sectors showed positive variations in productivity, indicating that there were considerable gains in this regard, through increases in the quality of capital (which may also indicate increases in quantity). Furthermore, the variations in workers and covariance were almost all positive, with the exception of Agriculture (both are negative) and Utilities (covariance is negative).

Such facts contrast sharply with the sectoral performances between 1991 and 2011 (the period 1981–1990 will not be commented on as they were years of acute economic crisis and, therefore, quite atypical in terms of productivity dynamics). By observing the last column of Figure 4, we notice that the smaller magnitude of all variations can be seen, but what differs most from the initial decades of the series is that not all sectors achieve a positive productivity variation for the period. The ones that stand out are Agriculture, Mining, Manufacturing and Utilities, with Trade Services being positive by a small margin. The other sectors show practically zero or negative productivity growth. Regarding variations in workers, the sectors that absorb labor are Services, mainly Business, and Construction. The others lose relative share of employment. Covariance changes are practically negligible over the period.

This difference in the sectoral dynamics of productivity growth and worker reallocation is the explanation for why the process of structural change was so different between the periods of 1950–1980 and 1991–2011. While, in the first, the general increase in productivity favors a wider range of forms of structural change as it does not matter much to which sector the

workforce is moving, since all sectors have their productivity growing, in the second time period, the sectors that have a positive performance in its contributions to the within effect, Agriculture, Mining, Manufacturing and Utilities, are the ones that witnesses their relative participation in aggregate employment to decrease. Thus, the sectors responsible for growth in aggregate labor productivity are not employing more workers, which are being absorbed by sectors whose relative productivity gains were very small or negative. When the sectors with the lowest productivity growth are those that attract new workers, there is a structural change that reduces growth, as Rodrik *et al.* (2016) attest.

The result is compatible with the findings of McMillan and Rodrik (2011), Arend *et al.* (2016) and Nassif *et al.* (2020), who also concluded that the Brazilian structural change process after 1980 reduces growth and productivity. The contribution of this paper to the debate is to show that the reason for the difference in labor productivity growth between the periods 1950–1980 and 1991–2011 is linked, mainly, to differences in the mechanics of the structural change process and not just in the magnitudes of growth in sectoral productivity. In the next section we discuss possible causes for this behavior.

In terms of international comparisons, this pattern of structural change suffered by Brazil is similar to several countries in Latin America and Africa, according to Timmer *et al.* (2015). The countries on both continents have in common the fact that they have undergone processes of structural change that have reduced growth since 1990. However, the level of productivity and relative weight of the industrial sector are higher in Latin America, despite its growth in labor productivity being lower than that of Africa between 1990 and 2010. The trajectory of these two continents contrasts with that of Asian countries, whose productivity grew, on an annual average, 3.6% in the same period, compared to 1.8% in Africa and 0.9% in Latin America [12] (Timmer *et al.*, 2015). The process of structural change in Asia accelerated economic growth due to the dynamic between effect, which we call the covariance effect. While in Latin America and Africa this effect practically nullified the gains from the (static) between effect, in Asia it showed a variation very close to zero. This means that expanding sectors in Africa and Latin America absorbed workers whose marginal productivity was lower than current (at the time) productivity. Therefore, an interesting line of future investigation would be to research growth patterns between continents and attest to their differences in the services sector, especially business and trade services.

5. Factors responsible for the growth-reducing structural change

There are a series of factors that could be listed as possible causes for Brazilian structural change after 1990 being growth-reducing. In this section we explore two of these possible factors. The aim here is to debate them in order to contribute with alternatives to overcome the stagnation in productivity.

The first factor to be discussed is based on Baumol's model (1967), which, in its original version, concludes that due to the services sector being stagnant in terms of contribution to productivity growth, the transfer of resources to these activities comes with it a tendency for the growth rates of productivity and GDP to fall. In Baumol's model, the aggregate economy can be grouped into two types of activities, namely: (1) those in which the increase in labor productivity is cumulative and done through innovations, capital accumulation and economies of scale; and (2) those that present irregular and sporadic growth in their production per worker. Both characteristics are much more assertive than just indications that there are sectors with different productivity growth rates, determined by their historical trajectories. In fact, this division is based on the manifestation of the technological structure of activities; This would be what defines whether labor productivity will grow quickly or slowly [13].

In this way, an economy could be divided into two sectors: a progressive one, in which the product per hour worked grows cumulatively according to any fixed productivity growth rate; and a non-progressive one, in which labor productivity is constant. In the one where productivity does not grow, the unit cost will grow without limits, while in the progressive one the unit cost will remain constant. Thus, there is a tendency for the relative product of the non-progressive sector to shrink, as it cannot be more efficient. However, if the ratio of the products of the two sectors remains constant, an increasingly larger part of the workforce will need to be transferred to the non-progressive sector. This happens because the increase in productivity in the progressive sector saves more and more labor, which, in this two-sector model, will only have the option of being employed in the non-progressive sector (it can be argued that perhaps an alternative would be unemployment. In any case, it does not seem like a hypothesis capable of solving the economic problem involved in the issue). Ultimately, all workers will end up in constant productivity activities. Therefore, any attempt to achieve balanced growth in a world of unbalanced productivity will lead to a declining growth rate relative to the growth rate of the labor force. Which means that if productivity in a sector and the total workforce remain constant, the economy's growth rate will ultimately approach zero.

Therefore, if productivity per man hour rises cumulatively in one sector, relative to the rest of the economy, while wages rise across all activities, then relative costs in the non-progressive sector will also rise. This means that any technical progress that increases the productivity of the progressive sector ends up increasing the relative costs of the non-progressive sector via wage increases provided by productivity gains. If the relative costs of various sectors are rising for reasons outside their control, then their relative shares in total output are very likely to be falling. If they are not, that is, if their relative shares remain constant, then an increasingly larger part of the workforce will need to go to these sectors, making them structurally giant and with falling productivity. Thus, the economy's growth rate will not be able to maintain itself and will slow down.

As seen in the previous section this is the case of the Brazilian economy as shown in Figure 1. The sector's relative shares in the aggregate product did not undergo significant changes from 1950 to 2011. According to Baumol's model, then, non-progressive sectors should attract more resources from the economy compared to others. In this case, they must attract more workers than other sectors. This forecast was fulfilled in the Brazilian economy from 1991 to 2011 (Figure 2), when the Agriculture, Mining, Manufacturing and Utilities sectors increased their labor productivity while decreasing their share of employment. In contrast, the five service sectors plus construction absorbed labor and ended up with reductions, or very small gains, in their relative productivity. Therefore, Baumol's model offers an explanation for the stagnation of the Brazilian economy by showing that if the added value structure of an economy remains constant, sectors with lower performance in terms of productivity tend to gain greater relative weight in the aggregate employment structure and, therefore, cause a fall in the rates of aggregate productivity and growth.

Baumol (1967) also discusses practical examples of his model related to problems faced by the American economy at the time of his research. It is impressive how similar the problems are to those faced by Brazil in this 21st century. For example, the author discusses how an increasing part of the workforce is absorbed by the retail services sector, which, by its nature, does not allow for cumulative and constant increases in productivity via capital accumulation, innovation and economies of scale. Another case is higher education activities, which, according to the author, absorbed in the USA an increasingly larger share of per capita income. As a higher education degree was considered essential for obtaining good jobs, families were already preparing to pay increasingly higher fees. Baumol's model predicts that, with constant productivity in this sector and if productivity continues to grow in other sectors in conjunction with salary adjustments, the higher education activity will see its relative costs increase, causing it to be forced to increase its fees charged. This would not

be something temporary, as this activity has the characteristic of being non-progressive, in terms of labor productivity, which makes it a sector that requires increasingly more resources to operate.

These examples shape an economy in which manufacturing activity, which is part of those progressive sectors, tends to have increasingly lower relative costs and absorbs an increasingly smaller part of the workforce. If this is happening to this sector, non-progressive activities, in turn, are necessarily presenting rising relative costs and absorbing more and more labor, unless unemployment is increasing. Thus, it becomes increasingly difficult for an economy to maintain its growth rate.

Baumol *et al.* (1985) and Oulton (2001) propose extensions to Baumol's (1967) model. The first incorporates a new subclass of services, which is called "asymptotically stagnant" economic activities. Normally linked to the services sector, they fit into an intermediate category between progressive and non-progressive because they use considerably fixed proportions between inputs from progressive and non-progressive sectors. Thus, this intermediate sector, in its initial phases, would tend to experience rapid growth due to increases in productivity provided by resources coming from progressive sectors. However, over time, and following the propositions of Baumol's model, these productivity gains would decrease due to the transfer of the economy's resources to non-progressive sectors. Finally, ultimately a point would be reached where the performance of this asymptotically stagnant sector, in terms of costs and prices, would closely resemble the performance of the non-progressive sectors.

Oulton (2001) argues that the conclusion of economic stagnation in the Baumol model may be incorrect if applied to more advanced countries, as its logic only applies if all goods produced are final goods. If some of the activities produce intermediate goods, such as, for example, financial and business services, there would be the possibility of them compensating for the fall in productivity caused by non-progressive activities. The author develops a model that he calls endogenous structural change. In this case, what matters for an economy to continue growing is the reduction of resources necessary to produce a certain quantity of the final good, which, in the model in question, would be cars. The way in which this reduction would occur would be secondary to a positive result for the aggregate economy, impacting only on the magnitude of growth rates. The reduction of resources can occur directly via increased productivity in car production or indirectly through productivity gains in the intermediate business services sector, and the importance of this input in the production of the final goods will be crucial in determining the speed of growth of the aggregate productivity. I.e. if the elasticity of substitution between labor and business services is high, over time the business services as a proportion of car industry costs will increase and aggregate productivity growth will tend to accelerate. This view is very interesting, as it brings the notion that, perhaps productivity gains in sectors that supply inputs, and not final goods, are more important for the growth of aggregate productivity due to the spillover effect that they are capable of generating.

The second factor to be discussed as a cause of the Brazilian growth-reducing structural change is deindustrialization. This is a phenomenon that has affected almost all economies. According to Tregenna (2009), between 1980 and 2003, only 11 countries managed to increase their manufacturing production both in absolute levels and in relation to GDP [14]. Most of the countries surveyed by Tregenna (2009) fit into the category that suffered a fall in manufacturing employment and relative product share, but with growth in industrial production. Therefore, it could be said that this would be the normal deindustrialization process during the period analyzed. Brazil was not included in the study because the author claimed that did not find a continuous series of manufacturing employment for the years researched. Observing Figures 1 and 2 in this paper together with the information on added

value of the manufacturing industry sector found in the GGDC10 from 1950 to 2011, it is possible to affirm that Brazil fits into the most common pattern of deindustrialization.

The question that remains is whether or not Brazil is a case of premature deindustrialization. Both Palma (2005) and Rodrik (2015) show that the inverted U-shaped relationship between GDP per capita and people employed in the manufacturing industry has become less steep and the inflection point of the curve has been decreasing over time, for developed and developing countries. Palma (2005) presented a new concept of Dutch disease and stated that the "extra" deindustrialization that Latin American countries have been suffering would be a result of the adoption of liberal policies at the beginning of the 1990s. Having estimated the relationship between GDP per capita and the participation of the manufacturing industry employment in the aggregate product for a series of countries, the author showed that the slope of the curve and its maximum point are smaller with each passing decade and that these two characteristics are also different when dividing the sample in countries that seek to obtain a surplus in their balance of payments through exports of industrialized products and those that seek to finance the import of manufactured goods through a surplus in primary commodities. The slope and the maximum level is smaller for the second group [15]. As Brazil, and several South American countries, moved from the first to the second group as a result of political choice for a new trajectory of economic development, one more in tune with economic liberalism, thus, abandoning the import substitution policy, Brazil and these countries have fallen to a lower curve of the relationship, showing lower levels of manufacturing employment for each level of GDP per capita. Adopting the new strategy made these countries suffer similar consequences, in terms of changes in the manufacturing industry, as those that contracted the Dutch disease due to having discovered new reserves of primary resources [16].

Rodrik (2015) estimated the level of GDP per capita at which the maximum point of industrialization was reached for manufacturing employment and for the share of real manufacturing product in GDP, before and after 1990 (the author himself admits that the definition of the year is arbitrary, but is consistent with the sample used and previous estimates). Before 1990, employment peaked when GDP per capita was approximately 11 thousand dollars and the maximum product was reached at 47 thousand dollars. After 1990, these values were, respectively, 4.2 thousand dollars and 20.5 thousand dollars, therefore there was a significant reduction. For the author, the most likely cause for deindustrialization in developing countries is related to international trade, more precisely, with the commercial opening of these countries to international exchanges. First, those who did not have a solid advantage in manufacturing goods reversed their import substitution process and became importers of manufactured products. Secondly, by opening up trade with developed countries that were undergoing a process of deindustrialization, they "imported" this phenomenon by being exposed to the same relative price trends. This is because, even though developing countries have not achieved high technological progress, global prices have fallen as a result of the fall in relative prices in the leading economies.

The discussion about premature deindustrialization presupposes the Kaldorian notion of economic development and the importance of the manufacturing industry as an engine that drives an economy and is capable of causing spillovers and positive externalities. Works such as those by Szirmai (2012) and Szirmai and Verspagen (2015) empirically investigated these statements and found that the manufacturing industry was very important for economic growth between 1970 and 1990, but, in subsequent decades, the positive relationship between these two variables is no longer significant, indicating, according to the authors, an increasing importance of services in the performance of an economy. However, all the catching up experiences analyzed since 1970 occurred through the industrialization of countries, that is, the services sector may be becoming an engine for economic growth, but

there is no record of developing countries reducing their distance to developed countries without the growth of the manufacturing industry.

Finally, Tregenna and Andreoni (2020) investigated the subsectors of the manufacturing industry and showed that even within this sector there are activities that have greater potential to generate positive externalities. The greater the technological content, the greater the probability of that activity, or subsector, of providing the acceleration impulse for growth. This evidence indicates that the manufacturing industry is not a homogeneous sector and that policies that promote some subsectors, but not all, can also be effective in improving the productivity of the aggregate economy.

The two factors presented in this section are responsible, to a greater or lesser extent, for the way in which the Brazilian structural change process took place and for the performance of labor productivity. Despite being very important and probably being the most relevant they are not the only ones, since other factors must also have an influence on the matter. While Baumol's model denotes the importance of the services sector in more advanced stages of development, the issue linked to deindustrialization shows that a country without industry will not even be able to generate an intermediary services sector with high added value. Furthermore, without the manufacturing industry a country will have difficulty reaching the per capita income levels of developed economies.

6. Final considerations

Brazilian labor productivity and its process of structural change was investigated from 1950 to 2011 using the Groningen Growth and Development Center's 10-Sector Database and the shift-share decomposition method. The results showed the differences in this process before and after 1980. In short, between 1950 and 1980 there were gains in labor productivity via an increase in economic fundamentals such as the quality of capital, labor and innovations. In this way, the change in structure, through worker relocations, managed to induce economic growth. However, from 1991 to 2011, the sectors that achieved gains in labor productivity did so with a reduction in labor. Meanwhile, those that absorbed workers ended up showing stagnant or negative results for labor productivity. This scenario represents a structural change that reduces growth. The contribution of this article to the topic was to expose, in more detail, how the dynamics occurred between the ten economic sectors both between 1950–1980 and 1991–2011.

The last section of the paper dealt with two possible causes for the stagnation of labor productivity and some factors that contributed to the structural change occurring in a less than desirable manner from 1991 onwards. Deindustrialization and the lack of dynamism in the intermediary services were highlighted as variables that deserve special attention. In this sense, with the goal of accelerating the growth of Brazilian labor productivity, two points of economic policy are suggested: (1) to adopt an industrial policy; and (2) to encourage innovation and productivity gains in the intermediary services sector.

All developed countries have some type of industrial policy to encourage and promote competitiveness gains in their industry. The form of incentives varies from country to country. It is necessary to understand the characteristics of the Brazilian economy and propose policies that are most likely to be successful in this case. It is worth noting that even though some industrial policies with dubious results were adopted in Brazil's recent past, this type of initiative has been used with greater intensity by developed countries to try to reverse their deindustrialization processes. The ultimate objective in Brazil should not be to return industrial participation to what it was in the past, in terms of added value and employment, but rather, first to avoid a disastrous scenario of a premature deindustrialization and, secondly to assist the manufacturing industry with the potential to compete in the international market to raise international currency in order to alleviate balance of payments restrictions.

Industry is essential in the advanced stages of economic development, a moment in which the economy finds itself with a greater demand for the services sector, as industry demands intermediary services such as transport, financial services and a series of business activities. With economies increasingly focused on the services sector, a second option to improve productivity is to encourage the part that produces intermediary services, since these are suppliers of a series of other services and industries, so the productivity gains arising from these activities have the potential to spill over into the rest of the economy. A good example of the Brazilian economy is its banking sector, which is considerably innovative. Innovations in banking activity, such as the PIX service developed by the Central Bank of Brazil, help reduce transaction costs in the aggregate economy and, in the end, bring competitiveness gains to national companies in the face of international competition. The Brazilian challenge is to ensure that the entire intermediary services sector is innovative.

Notes

1. Agriculture, manufacturing, other industries, market services and non-market services.
2. Thirty-nine countries in total and the regions of Latin America, Africa, Asia and high-income countries. They built the database for African countries that are not in the GGDC10.
3. Personal Services and Government Services were grouped together due to the difficulty of obtaining information from some African countries.
4. Which are: Agriculture and Mining; Manufacturing; Construction and Energy Infrastructure; Highly skilled labor services; and Low-skilled labor services.
5. The division between a formal and an informal sector is also used by several authors, according to Gollin (2014).
6. The National Classification of Economic Activities (CNAE) produced and used by Brazil is derived from ISIC. They are similar, but not the same.
7. The data only consider formal employment. If informal workers were taken into account, perhaps the participation of Trade Services would be even greater.
8. The displacement of agricultural workers, for example, to higher productivity sectors could generate a negative third term even if it were accompanied by a positive variation in the productivity of that sector. Such an event, when observing the negative sign in the equation, would seem to be detrimental to productivity growth when, in fact, the displacement of employment from the agriculture sector to others with greater productivity is something that would be desirable in the process of structural change and seen as a better use of resources. See Timmer and Szirmai (2000) and Timmer and de Vries (2009) for a discussion of the theoretical assumptions adopted by the method.
9. The other three forms do not have the third term. When doing so, depending on the modeling used, its result ends up fully inserted into the first or second terms, or divided equally between both.
10. For the interval 1950–1979, Nassif *et al.* (2020) found 131% for the between effect and 116% for the within effect. The other periods also show differences; however, they do not change the order of the effects or their sign in relation to those found here.
11. Despite having the best performance in productivity gains, as is clear in Table 2, their participation in the labor market is negligible. Therefore, as in Equation (1) the variation in productivity is weighted by the relative sectoral employment share, the result, in terms of the value that goes into the decomposition calculation, ends up being much smaller.
12. African countries included: Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania and Zambia; Asian countries: China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand; Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Venezuela.

13. The theory is based on three premises, which are important for understanding the model, but, as the author highlights, none of them are essential to its main argument: (1) all costs, except labor costs, can be ignored; (2) wages in both activities of the economy have the same trajectory and behavior; (3) nominal wages will grow vis-à-vis those of the sector in which productivity is rising. These assumptions are important for the model's conclusions because the need to maintain wage levels across all sectors will prove to be a burden for those with low productivity growth.
14. The 11 countries are: Austria, Belgium, Estonia, Finland, Ireland, South Korea, Pakistan, Poland, Slovenia, Sweden and Switzerland.
15. See the figures by Palma (2005) on pages 77, 80, 83 and 84.
16. See Palma (2005), page 91.

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