Sectoral capabilities and productive structure:
An input-output analysis of the key sectors of the Brazilian economy

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Abstract

The complex relationship between production structure and economic growth has been the subject of considerable debate among Brazilian economists. This debate resounded after the 2000s, when Brazil experienced a period of growth from the rise of commodity exports, which contrasted with the stagnation observed in the previous two decades. To analyse the capacity of commodity exports to generate long-term economic growth, this paper assesses this sector's performance and its effects on related sectors in the upstream supply chain through input-output tables. These analyses lead to two main conclusions. First, exports of agricultural and mineral commodities exhibited little capacity to boost the economy because they have the lowest linkage indices. Second, a development strategy should consider comparative advantages in the economy while considering the advantages of a production structure oriented toward expanding manufacturing. The analysis of the Brazilian production structure demonstrated that sectors related to manufacturing can stimulate other sectors, such as sophisticated services, because of their high linkage effects on other sectors.

Keywords: Commodities, manufactured products, production structure, economic growth, development, input-output model, growth models.

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1. Introduction

After at least two decades of slow economic growth, the Brazilian economy gained momentum in the early 2000s. The growth cycle that followed, especially after 2003, was characterised by income redistribution, a steady decrease in unemployment, and increases in investments. This scenario led to intense economic growth in the following years. Given the importance of this economic growth to policy making, researchers put forth a vast range of interpretations that sought to determine the factors and instruments that triggered this process.[4] Over the last decade, changes in the intensity of trade flows began to be observed more clearly. Strong economic performance and intense international trade were accompanied by an increase in commodity prices that increased Brazilian exports by approximately 262%, almost twice the global average of 135%. This new economic reality resulted in an increase in Brazilian exports that rose from 10% of the gross domestic product (GDP) in 2000, peaking to 16.4% in 2004 and dropping to 11.2% in 2010 due to the global financial crisis. Despite this decrease in exports, Brazilian commodities played a key role in the economy's dynamism that was highly associated with Asian demand, most notably in China (Prates, 2006 and Rocha, 2011).[5]

Once the international market began to demand Brazil's main export products, economic growth led by exports of primary products, especially commodities, assumed a prominent position in interpretations of the growth experienced during that period. Some economists suggested that expansion based on the production and export of commoditised sectors do not have a negative effect on the economy. In addition to being capable of generating income in export sectors, primary sectors have indirect effects on other productive chains. Primary sectors also have the capacity to generate income beyond consumption that could resupply the domestic production and related services (Schultz, 1964; Lipton, 1968; Chayanov, 1966). This line of thought has regularly refuted the necessity of industrial and foreign trade policies. These economists note that state intervention of industrial sectors would promote an "artificial" industrialisation incompatible with international patterns based on a competitive free market.

In contrast, several studies have attempted to demonstrate the limitations of promoting a country's productive and international trade structure based on a free-market strategy. Both classic Kaldorian interpretations (Kaldor, 1966, 1981; Cornwall, 1977, Thirlwall & Hussein, 1982; McCombie & Thirlwall, 1994a, 1994b; Verdoorn, 1949; Thirlwall, 1979; Dasgupta & Singh,2006; Dixon & Thirlwall, 1975, Moreno-Brid, 2003) and those based on the structuralist approach of Latin American thinking (Prebisch 1986, Singer, 1950; Furtado, 1961 and Tavares, 1998) have emphasised the limitations of promoting economic development based on a productive trade structure of low-value-added products. This school of thought is commonly referred to as developmental theory. Developmental theorists observe the negative effects of currency appreciation in the manufacturing sector caused by exports of commodities, a process known as the "Dutch disease". These theorists argue that the existence of comparative advantages in natural resources would significantly increase the exports of low-value-added products, such as commodities, in turn resulting in a major inflow of foreign currency into the domestic economy and the appreciation of the domestic currency in real terms. Traditional service sectors are less affected by these events because manufacturing and more sophisticated services are tradable and their corresponding demand is partially supplied by imported goods (causing a demand leakage). If commodity prices rise, the implications would be more serious for the domestic industry than for non-tradable sectors. The exchange rate would continue to appreciate, and the competitiveness of higher-value-added products would be reduced, possibly triggering a process of "deindustrialisation" of the economy.[6]

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[4] The growth rate has decreased since 2011 in Brazil (Ipeadata).

[5] Regarding the recent rise in commodity prices, see Prates (2007).

[6] See Corden and Neary (1982), Palma (2005) and Bresser-Pereira (2008). The exchange rate appreciation can also occur because of capital inflow.

The main argument of those who criticise economic growth based on primary product exports is that manufacturing is the main engine of economic development[7]. Rosenstein-Rodan (1943), Prebisch (1949), Lewis (1954), Rostow (1956), Furtado (1961) and Kaldor (1966) were some of the first intellectuals to emphasise the importance of manufacturing for economic development. According to these scholars, development is essentially a process of structural change. Sustained economic growth is associated with the diversification of domestic production, i.e., the generation of new activities to expand the possibilities of production, linkages and higher-value-added goods by providing incentives to manufacturing. Similarly, Chenery *et al.* (1986) argue that economic development is triggered by productive transformations induced by an increasing demand for product diversity and technological progress. These transformations would also lead to a more productive use of inputs and increased productivity. The industrialisation process feeds itself and diversifies the production structure. These changes in demand resulting from growth entail a dynamic element that transforms the production structure. These changes create a shift in the composition of production and supply that requires new investments, which produce technological improvements that further stimulate demand.

Hirschman (1958) has studied the impacts of stimulating certain sectors in detail and argues that a development strategy should focus on ensuring investment in sectors that can generate backward linkages (BLs) and forward linkages (FLs). Examples include stimulating the production of inputs used in production and generating economies of scale inside a sector or the production of intermediate goods that can be used as inputs in other sectors. These strategies also lead to productivity gains and cost savings in sectors in the later stages of the production chain. Thus, this paper evaluates the dynamic effects of a development strategy based on commodity exports, such as the strategy adopted by Brazil in recent years. This evaluation compares possible production linkages that can be created by stimulating the sectors in which Brazil enjoys comparative advantages in production with linkages that could be generated by providing incentives to manufacturing. This paper also assesses whether this strategy can be successful considering production diversification and thus whether it can promote economic growth.

Both strategies increase the demand for services. In the primary export-led strategy, the increase in demand for services is explained by income gains because of increased export revenue and the appreciation of the exchange rate, as noted by Corden (1982) and Bresser-Pereira (2008). The increased demand can target traditional services, such as personal services, or modern services, such as logistics or consulting (Rowthorn and Coutts, 2004; Palma, 2005; Dasgupta and Singh, 2006). In the manufacturing-led strategy, the increase in demand for services results from income services and servitisation, which is defined as the expansion of more sophisticated and high-value-added service activities related to manufacturing, such as marketing, design and software (Lodefalk, 2010; Nordås and Kim, 2013). Therefore, we will also analyse the linkages of the service sectors.

For this purpose, this paper will adopt a methodology based on input-output tables. The remainder of this paper is organised as follows. Section 2 provides a brief analysis of the main features of the post-1990s Brazilian development model. Then, the input-output methodology adopted in this analysis is presented is presented in Section 3. Production multipliers, Hirschman-Rasmussen backward and FL indices, and pure normalised backward and FL indices comprising all productive sectors are calculated in Section 4. Finally, concluding remarks are provided in Section 5

2. The Brazilian development model from the lost decade to post-1990s

The crisis of the 1980s disrupted the economic growth-promoting mechanisms adopted by Brazil in previous decades. This crisis occurred because of a marked contraction in international credit markets and a repatriation of capital flows to central economies. The state apparatus was weakened by the deterioration of the global macroeconomic environment, high government indebtedness in the 1970s, and the debt nationalisation process, which forced the government to bear the burden of private decisions. The

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[7] Rodrik (2007), Szirmai (2009, 2012) and Fagerberg & Verspagen (1999) also support this argument.

government also experienced a fiscal and financial crisis because these difficulties undermined its ability to promote investment and development to the same degree as in previous decades.

Under these circumstances, the Brazilian development model began to be strongly criticised. Heavy criticism developed regarding both the conduct of Brazil's economic policy in the previous decade and the limits of the model applied to the Brazilian economy since the 1930s. According to Bacha and Bonelli (2005), economic stagnation in the 1980s was a consequence of not only macroeconomic imbalances but also a greater structural crisis. This crisis arose from the exhaustion of a development model built on a closed economy marked by strong state intervention and based on the import substitution industrialisation (ISI) model. It was argued that a radical shift in Brazil's economic policy was required and that the foundations of the development model based on ISI should be replaced. ISI provided to be an incentive to a Chenery-style industrial development model (strengthening the industry of intermediate inputs with major linkages in the production structure). However, free-market economists argued that ISI was based on protectionist policies that would give rise to distortions in relative prices and in the allocation of resources in the economy, thus causing inefficiency (Bonelli, 2005).

However, the ISI process in the Brazilian economy began to show signs of exhaustion in the 1980s as the import coefficient decreased drastically. The average import coefficient (calculated at constant prices) was 25.3% in the 1920s, decreasing to 11.7% in the 1950s, 5.6% in the 1960s and 4% in the 1980s[8]. The transformation of the Brazilian economy's production structure reached a level of diversification that made domestic demand less dependent on global production, thus bringing the ISI implementation cycle to an end.

Meanwhile, in the mid-1960s, the development strategy applied to the Brazilian economy led to a marked increase in the exports of manufactured goods. This increase was supported by an industrial policy based on high foreign trade tariffs and high subsidies to neutralise the Dutch disease (Bresser-Pereira, 2008)[9]. Manufactured goods comprised only 6.2% of exports in 1964 (initial available data) and reached an average of 54.1% in the 1980s. This number only began to decrease in the second half of the 2010s, after production started to meet the external demand for commodities (averaging 37.8% from 2010 to 2011).[10]

The combination of this previous import substitution process and a subsequent increase in the exports of manufactured products (always supported by industrial policies that favoured both a managed exchange rate and a public spending scheme promoting the development of strategic sectors) contributed significantly to Brazil's industrialisation process. The share of manufacturing in value-added products rose from 15.1% in 1947 (initial available data) to 21.2% in the 1970s[11], during the import substitution phase, and remained relatively high at the time that the relative share of exports of manufactured goods were increasing. The share of manufacturing in value-added products started to decrease in the 1980s because of the aforementioned crisis and continued to drop in the following decades when the government ceased the neutralisation of the Dutch disease and most industrial policies. The exchange rate chronically appreciated, and commercial and financial openness were implemented. The share of manufacturing in value-added products decreased to 16.8% in the 2000s and 15.8% in the 2010s.

Therefore, since the 1970s, economic development in the Brazilian economy had been geared toward foreign trade, particularly the export of manufactured goods associated with the end of the import substitution process. Thus, it did not appear that production conditions were deteriorating or that the production structure was inefficient because, among other factors, a substantial percentage of manufacturing production was facing international competition. However, the country's fiscal situation

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[8] Source: IPEADATA.

[9] According to Bresser-Pereira (2009: 144), to neutralise the Dutch disease, "the government did not levy a tax on the exports of commodities because it felt it lacked the political capital to do so, but the tax was adopted in practice through a 'confisco cambial' implied in import tariffs and subsidies to manufactured goods exports". This was an "industrial policy" that involved a macroeconomic policy: the determination of the effective exchange rate after tariffs and subsidies.

[10] Source: Department of Planning and Development of Foreign Trade – DEPLA (Brazil).

[11] Source; IPEADATA. The shares were calculated based on the series at constant prices.

and external accounts deteriorated, partially due to the financing of these strategies. This deterioration and the weakening ability of the state to continue this process contributed to the revival of arguments in favour of free market ideology, in line with the Washington Consensus.

A lower participation of the state in the economy and the promotion of competitiveness as the main engine of productivity growth were the basis of the new development model established in the 1990s. These principles were based on the Washington Consensus (Williamson, 1989)[12] to install a market economy that would promote greater productivity through specialisation in production and by targeting investments to sectors in which Brazil enjoyed comparative advantages. Policies designed to promote the manufacturing sector lost strength during this period and were virtually abandoned as a result of the then-prevailing maxim that "the best industrial policy is no industrial policy" (Stallings & Peres, 2000). Therefore, as a result of market forces, the 1990s were marked by major economic changes that resulted in a productive restructuring of the Brazilian economy. According to Franco (1998), this model would spearhead a process of industrial restructuring that would increase the competitiveness of the Brazilian economy. This model would eliminate less efficient companies and sectors and induce new technologies so that the country would be able to compete in the international arena.

In Brazil, this strategy took form through reductions in quantitative controls and import tariffs and through the absence of public policies focused on promoting growth in strategic sectors for the country's development. The trade liberalisation process focused on increasing imports without providing incentives for exports. This model virtually eliminated non-tariff barriers to trade, [13] and custom tariffs were reduced considerably based on the country's structure of comparative advantages[14]. This environment, combined with currency appreciation, resulted in a second large wave of reductions in the share of manufacturing in value-added goods in the second half of the 1990s[15].

The trade liberalisation process focused more on imports because better conditions were not created to improve exports, such as changes in financing and logistics, and previous policies to stimulate exports were abandoned. Moreover, the domestic currency appreciated in real terms—a long-term appreciation caused by the fact that the industrial policy that neutralised the Dutch disease ceased with trade liberalisation (Bresser-Pereira 2009). These factors constrained access to foreign demand and investments. Thus, investments increased to a lesser extent than expected in both the public and private sectors during this period, decreasing from an average rate of 19.4% between 1990 and 1994 to 17.1% between 1995 and 1999[16]. This decrease was reflected in an average annual growth rate of 2.9% in the 1990s, significantly contrasting with the average annual growth rate of 8.7% in the 1970s[17].

To face the challenges of the new economic environment, companies began to take strict adjustment measures during the 1990s to rationalise their production by replacing imported inputs with local inputs[18]. Import penetration coefficients increased significantly between 1990 and 1998. Thus, as argued by Belluzzo and Almeida (2002), there was a "shrinking" of supply chains, which were also affected by "predatory" imports. Industrial companies began to look for ways to improve their competitiveness by cutting costs, replacing local products with imported inputs and reducing inter-

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[12] The ten prepositions were the following: (1) fiscal discipline, (2) reduction of public spending, (3) tax reform (4) interest rates determined by the market, (5) exchange rates determined by the market, (6) liberalisation of imports, (7) liberalisation of foreign direct investment flows, (8) privatisation of state enterprises, (9) economic and labor deregulation, and (10) respect for intellectual property.

[13] According to Carneiro (2002), nontariff barriers to trade, which many saw as the main protectionist instrument, were completely removed after Annex C (a list of 1,300 products whose imports were forbidden because similar domestic products were available) was abolished.

[14] Nominal import tariffs were reduced by 55.3% between 1990 and 1994, with the maximum tariff not exceeding 40%.

[15] The first phase of the Brazilian deindustrialisation process was in the 1980s, and it might be associated with significant macroeconomic imbalances—fiscal crisis, high foreign debt and inflation—observed during that period.

[16] There was a 7.4% annual reduction in investment in the productive state sector between 1981 and 1989; the investment rates in the private sector remained unchanged in real terms (data extracted from Carneiro, 2002).

[17] The data presented here were calculated by IBGE.

[18] See Rocha (2011), Marconi and Rocha (2012) for more information on the imported input coefficients.

sectoral linkages still under development (Rocha, 2011). According to the Brazilian Institute for Geography and Statistics (IBGE)[19], the penetration coefficient for intermediate goods rose from 2.7% in 1990 to 10.5% in 1998. The substitution process was even more pronounced for manufactured intermediate goods: whereas the penetration coefficient was 6.1% in 1990, it increased to 21.9% by 1998. Thus, as local inputs were largely replaced by imports, the process of developing domestic production required an increasing amount of foreign currency, which made it increasingly difficult to employ the same growth strategy[20]. As argued by Laplane and Sarti (2006, p. 276), from a trade balance perspective, this process "turned the surplus in the trade in manufactured goods registered in the first half of the decade into a deficit from 1995 on, clearly indicating that it would be difficult to keep the economy on a growth path. The trade balance was more significantly negative precisely in 1997, when industrial production was growing at the highest rates, reinforcing the interpretation that the increasing imported contents of local products were generating an even more pronounced deficit." Exports of manufactured products recovered for several years in the 2000s, possibly because of the depreciation of the national currency and the growth of world demand. However, this movement was interrupted by changes in the global commodity market, when the 2008/2009 financial crisis took place.

As a result of an extremely weakened production structure resulting from over a decade of strongly market-oriented policies, production and exports of primary products became the engine of Brazil's growth. A new cycle of economic expansion began in 2002 with the so-called boom of commodity prices. In mid-2004, global demand began to rise more intensely because of the growth of the Asian economies, particularly that of China. This shift (along with a monetary policy that caused a significant increase in the differential between domestic and external interest rates) resulted in a strong appreciation of the domestic currency. Additionally, this shift caused a consequent increase in imports of manufactured goods, which increased by 155% at constant prices between 2002 and 2008[21], and a reduction in the manufacturing of value-added products[22].

This scenario contributed to the third phase of reductions in the share of manufacturing in value-added goods in the Brazilian economy after 2002. At this time, the appreciation of the local currency undermined the competitiveness of Brazilian manufactured products abroad. At the same time, there was an increase in exports of Brazilian primary products to Asia, which also caused commodity prices to increase. The trend of rising commodity prices was only reversed in 2009 because of the 2008/2009 financial crisis; however, these prices still remained comparatively high.

As a result of this new dynamic, many questions emerged regarding the composition of the domestic production structure, specifically concerning the sectors that boosted the economy. The share of the services sector in value-added products increased by 4.1% between 1995 and 2009[23]. The shares of mineral and agricultural commodities also increased in that period (12.1%), whereas the share of the industrial sector decreased by 12.6%. The share of the manufacturing sector increased to 17%. Growth in the commodities sector stimulated services activities, including both traditional and modern services. Shares of sales and transports decreased by 2.4% and 2.3%, respectively. Real estate and financial intermediation shares increased by 9.4% and 18.4%, respectively. Business services (includes traditional and modern services) increased by 20.9%. Community, social and personal services decreased by 7.7%.

In the past, the Brazilian economy adopted a development strategy based on the manufacturing sector. In more recent years, Brazil has turned to a primary export-led strategy. In the next sections, we

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[19] Extracted from Carneiro (2002).

[20] As discussed in Rocha (2011, p. 55), "substituting local inputs with imported ones was seen as the easiest way to meet demand and revealed the contradiction between striving for efficiency gains at the microeconomic level and the sustainability of the process at the macroeconomic level, i.e. the contrast between competitive pressure and the weakening of industrial chains."

[21] Calculated by the authors based on information from FUNCEX (Foreign Trade Study Center Foundation).

[22] Exports of manufactured products increased by 80.5% on the same comparison basis, with nearly half of the variation observed for imports.

[23] We considered the period for which data for National Accounts were available under the same methodology and disaggregation.

will evaluate the capacity of both strategies to increase economic growth using indicators that measure the impact of the production of one sector over another sector.

3. Theoretical foundations of the input-output model

This study used input-output analyses to analyse the capacity of commodity production to improve the Brazilian economy *vis-à-vis* manufactured goods because these models can incorporate inter-relationships between various industries in the Brazilian economy. Using this methodology, it is possible to empirically investigate the economic role of a productive sector without restricting the analysis to its "direct effects" on the economy regarding generating production, employment, value-added products, tax revenue, and exports. With this method, it is possible to also investigate the "indirect effects", i.e., the effects that a sector can have on other sectors through channels established by input/output transactions between different economic sectors.

To calculate these indices, input-output matrices from 2000 to 2008 were used (55 sectors) based on the National Accounts published annually by the Brazilian Institute for Geography and Statistics (IBGE). Because of the non-linear periodicity of the information contained in this publication, Brazilian matrices were estimated for each year of the study period according to the methodology presented by Guilhoto and Sesso Filho (2005) based on preliminary data of Brazil's National Accounts. This methodology consists of a procedure for combining information from the Table of Resources (V) and the Table of Use of goods and services at consumer prices (U) published by the IBGE for the Brazilian economy. Next, to reduce the number of sectors required to assess the differences among manufactured products, commodities and non-tradables, the matrix was aggregated into 18 sectors distributed in these two groups based on the proximity of their production structures. The correspondence between the sectors of the initial matrix (55 sectors) and the resulting matrix (18 sectors) is shown in Annex 1.

3.1. Theoretical foundations

The theoretical approach adopted in this study is based on the input-output model, which was originally developed by Leontief (1951). The economy's total production (X) is the result of the sum of the production intended for intermediate consumption by different sectors (Z) and the final demand. The economy's total production (X) also represents the extent to which sector j used goods produced by sector i in its total production and indicates the percentage of inputs sold to industry j by sector i in relation to the total production of sector j.

$$a_{ij} = \frac{Z_{ij}}{X_j}$$

(1)

where z_{ij} is the inter-sectoral sales of sector i to sector j and x_j is the total production of sector j. Thus, we obtain

$$X = AX + Y$$

(2)

By solving this equation, the total output required to meet the final demand can be expressed as

$$X = (I - A)^{-1} Y$$

(3)

where $(I - A)^{-1} = L$ is the inverse of Leontief's matrix.

Using Leontief's model, various analyses can assess the impact of demand variation on production, employment and value-added goods, among other variables. Based on the ratio between the

value of the variable K employed and the production of the corresponding sector, the direct coefficient (k) is calculated for each variable (e.g., employment, value-added goods, wages) as follows:

$$k_j = \frac{K_j}{X_j}$$

(4)

Once k is calculated, along with Leontief's inverse matrix (L), it is possible to calculate the amount of K directly and indirectly generated for each monetary unit produced for the final demand for each sector. This value is referred to as the generator, which relates production for final demand to a given variable of the economy. Thus, the generator of a variable K for each sector can be calculated by summing each column of matrix GK as follows:

$$GK = \sum_{i=1}^{n} \hat{k}_i \cdot L_{ij}$$

(5)

With the quotient between the generator and respective direct coefficient, it is possible to obtain the multiplier of variable K that associates the direct effect of a variable regarding its total (direct and indirect) effect on the economy as follows:

$$MK_j = GK_j / k_i$$

(6)

In this manner, multipliers for employment and production can be obtained[24]. In addition, the input-output methodology allows other indicators of economic importance to be calculated. The seminal works of Hirschman (1958) and Rasmussen (1956) allow one define the interrelationships between the sectors and the power of each sector in the economy to establish linkages. The Hirschman-Rasmussen BL indices determine the demand of a sector for other sectors, and the FL indices determine the degree to which this sector is demanded by other sectors. To calculate the Hirschman-Rasmussen BL index, l_{ij} is defined as the elements of matrix L, L^* is the average of all elements of L and L_{*j} is the sum of a column of L. The BL is expressed as follows:

$$BL_j = \left(L_{*j}/n\right)/L^*$$

(7)

The Hirschman-Rasmussen FL index is calculated from the matrix of coefficients in row (F) obtained from the intermediate consumption matrix (Z) and is expressed as

$$F = \hat{x}^{-1} \cdot Z$$

(8)

As in Leontief's inverse matrix, the matrix of Ghost is deduced with g_{ij} as follows:

$$G = (I - F)^{-1}$$

(9)

Considering G^* as the average of all elements of G and G_{i*} as the sum of the elements in each row, the Hirschman-Rasmussen FL index is obtained as follows:[25]

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[24] This paper used type I multipliers, which only consider multiplicative effects restricted to demand for intermediate inputs, without making household demand endogenous to the model. If household demand were endogenised in the system, the induced effect would be considered, and type II multipliers would be used (Guilhoto, 2009).

[25] For more details, see Miller and Blair (2009).

$$FL_i = \left(G_{i*}/n\right)/G^*$$

(10)

Sectors can be classified into the following four groups depending on their index values: (i) independent from (or not highly related to) other sectors if both linkage indices are less than 1; (ii) dependent on (or strongly related to) other sectors if both linkage indices are greater than 1, denoting sectors that play a key role in the economy; (ii) dependent on intersectoral supply (or stimulates production in other sectors) if only the BL index is greater than 1; and (iv) dependent on intersectoral demand (or dependent on the production of other sectors) if only the FL index is greater than 1. However, as observed by Cella (1984) and Clements (1990), these indices do not consider the production levels of each analysed sector.

To correct and refine the solutions presented by Cella (1984) and Clements (1990), Guilhoto et al. (1994) introduced the first version of what would be considered a pure linkage index, which later became known as the GHS methodology. Guilhoto, Sonis and Hewings (1996) present decompositions of Leontief's inverse matrix that integrate the main techniques used in input-output structures to decompose and distinguish the impact of an economic sector on its various components. The consolidated GHS methodology is based on a block matrix of technical coefficients (A):

$$A = \begin{bmatrix} A_{jj} & A_{jr} \\ A_{rj} & A_{rr} \end{bmatrix}$$

(11)

where A is composed of square and rectangular matrices. A_{jj} and A_{rr} represent square matrices of the direct technical coefficients of sector j and the remainder of the economy (entire economy minus sector j), respectively. A_{jr} and A_{rj} represent rectangular matrices of direct inputs purchased by sector j from the remainder of the economy and direct inputs purchased by the remainder of the economy from sector j, respectively.

Based on matrix A in (11), a triple multiplicative decomposition of Leontief's inverse matrix can be expressed as follows:

$$L = (I - A)^{-1} = \begin{bmatrix} L_{jj} & L_{jr} \\ L_{rj} & L_{rr} \end{bmatrix} = \begin{bmatrix} \Delta_{jj} & 0 \\ 0 & \Delta_{rr} \end{bmatrix} \begin{bmatrix} \Delta_j & 0 \\ 0 & \Delta_r \end{bmatrix} \begin{bmatrix} I & A_{jr}\Delta_r \\ A_{rj}\Delta_j & I \end{bmatrix}$$

(12)

where

$$\Delta_j = (I - A_{jj})^{-1}$$

(13)

$$\Delta_r = (I - A_{rr})^{-1}$$

(14)

$$\Delta_{jj} = (I - \Delta_j A_{jr}\Delta_r A_{rj})^{-1}$$

(15)

$$\Delta_{rr} = (I - \Delta_r A_{rj}\Delta_j A_{jr})^{-1}$$

(16)

From Leontief's model in (3) and Equation (12), we obtain the following:

$$\begin{pmatrix} X_j \\ X_r \end{pmatrix} = \begin{pmatrix} \Delta_{jj} & 0 \\ 0 & \Delta_{rr} \end{pmatrix} \begin{pmatrix} \Delta_j Y_j + \Delta_j A_{jr}\Delta_r Y_r \\ \Delta_r A_{rj}\Delta_j Y_j + \Delta_r Y_r \end{pmatrix}$$

(17)

Through this process, pure BL (PBL) and pure FL (PFL) indices can be deduced in their new definition as follows:

$$PBL = \Delta_r A_{rj} \Delta_j Y_j \qquad (18)$$

$$PFL = \Delta_j A_{jr} \Delta_r Y_r \qquad (19)$$

In Equation (18), the index indicates the impact of the value of the total output of sector j on the remainder of the economy, the net of demand for inputs that sector j produces for itself and the returns of the remainder of the economy for sector j and vice versa. The PFL in Equation (19) indicates the impact of the value of the total production of the remainder of the economy on sector j. The PBL and PFL are summed to calculate the pure total linkage (PTL) index for each sector of the economy, expressed in current values:

$$PTL = PBL + PFL \qquad (20)$$

However, because these indices do not consider the size of the sectors, which is an important aspect for identifying key sectors of the economy, a "normalisation" procedure should be applied to these indices based on the approach of normalised pure linkage indices. For this purpose, the pure indices of each sector are divided by the average of pure indices for the economy as a whole. Thus, the normalised PBL (PBLN) index, the normalised PFL (PFLN) index and the normalised PTL (PTLN) index can be represented as follows:

$$PBLN_i = PBL_i \bigg/ \left(\sum_{i=1}^{n} PBL_i \bigg/ n \right) \qquad (21)$$

$$PFLN_i = PFL_i \bigg/ \left(\sum_{i=1}^{n} PFL_i \bigg/ n \right) \qquad (22)$$

$$PTLN_i = PTL_i \bigg/ \left(\sum_{i=1}^{n} PTL_i \bigg/ n \right) \qquad (23)$$

4. Results

In this section, the results obtained using the proposed methodology based on the input-output analysis are presented in the following order: output multipliers, Rasmussen-Hirschman indices, PBLN indices, and PFLN indices.

The output multiplier indicates how much is produced for each monetary unit spent on final consumption. These multipliers incorporate direct and indirect effects to measure the impacts of a demand shock on the economy. Type I multipliers are used in this analysis. As seen from the first two columns of Table 1, the greatest multipliers of the Brazilian economy (greater than 2.0 for most years) were identified in six sectors: food/beverages, transportation equipment, chemical products, apparel/leather/footwear, petroleum, and metal products, with food/beverages and transportation equipment being the two most prominent sectors. Transportation equipment includes the auto industry. The apparel/leather/footwear sector also has a high multiplier effect and is labour intensive, making it important for the development of productive chains that employ large numbers of people. The three lowest multipliers in the tradable sectors are miscellaneous, mineral commodities and agricultural commodities. The miscellaneous and mineral commodities sectors are associated with a strong bias toward Brazil's comparative advantages. Finally, the analysis of the non-tradable sector shows that services have little capacity to stimulate the

economy, exhibiting the lowest ranks. Although construction and utilities appear with the highest multipliers among services, they are still lower than commodities' output multipliers.

The results of the analysis of multipliers can be complemented by Hirschman-Rasmussen FL and BL indices (columns 3-6 of Table 1). The BL index indicates the extent to which the output of a particular sector stimulates the production of its inputs. The FL index allows one to analyse the importance of a given sector as an input supplier. These indices allow one to investigate behaviour of the economy's internal structure and identify key sectors that depend on inter-industrial supply and inter-industrial demand or are relatively independent from the other sectors.

Located in the upper-right quadrant, the key sectors of the Brazilian economy in the 2000s were petroleum and chemical products. These sectors exhibited a high potential to boost other sectors of the economy in addition to being major input suppliers. The petroleum sector had the greatest capacity to supply inputs to the remaining sectors. Although it falls under the commodity category, petroleum is characterised by a high production rate for each monetary unit spent on final consumption. The petroleum sector is a supplier of inputs for manufacturing, the main industrialised products of the chemical products and synthetic materials sectors and the apparel sector [26]. The petroleum sector is not exported as a raw material, as are mineral commodities[27].

Table 1 - Output Multipliers and Linkage Indices – Average 2000-2009

| Sectors | Output Multipliers | | Linkage indexes | | | | Normalized pure linkage | | | |
| | | | Backward | | Forward | | Backward | | Forward | |
	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank
Agricultural commodities	1.77	10	0.97	10	1.14	7	0.81	8	1.98	2
Petroleum	2.18	3	1.19	3	1.45	1	0.37	16	1.36	7
Mineral commodities	1.97	8	1.07	8	1.21	5	0.48	14	1.31	8
Food and Beverages	2.35	1	1.29	1	0.86	13	2.51	1	0.65	10
Textiles and footwear	2.01	5	1.10	5	0.87	12	0.53	13	0.17	16
Miscellaneous	1.83	9	1.00	9	1.04	8	0.39	15	0.39	12
Chemical products	2.06	4	1.13	4	1.33	2	0.54	12	1.74	4
Metal products (incl. machinery)	1.97	7	1.08	7	1.00	9	0.70	9	0.59	11
Electric mat. and communic.	1.99	6	1.09	6	0.90	11	0.66	10	0.32	14
Transportation equipament	2.24	2	1.23	2	0.82	15	1.28	6	0.25	15
Utilities	1.70	12	0.93	12	1.29	4	0.23	17	1.06	9
Construction	1.75	11	0.96	11	0.67	16	1.55	5	0.33	13
Sales	1.42	18	0.78	18	0.95	10	0.91	7	1.68	5
Traditional services	1.51	17	0.82	17	0.84	14	2.41	2	1.90	3
Modern services	1.59	13	0.87	13	1.15	6	0.64	11	2.44	1
Business services	1.57	14	0.86	14	1.33	3	0.18	18	1.63	6
Health and education	1.51	16	0.83	16	0.57	18	1.79	4	0.06	18
Public admin.	1.52	15	0.83	15	0.58	17	2.03	3	0.11	17

Source: Elaborated by the authors based on the estimated Brazilian input-output tables.

There are no tradable sectors of the Brazilian economy in the group that are relatively independent from the other sectors (lower-left quadrant), indicating that there is a significant degree of dependence between several industrial sectors of the economy. This result may have been caused by the development process of Brazilian industry during the ISI period, when input production and inter-industrial demand were strongly stimulated. Located in the lower-right quadrant, the food/beverages and transportation

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[26] The highest increase in linkage indices in this sector was registered from 2004-2006, during which Brazil became self-sufficient in oil production.

[27] According to the National Accounts, Brazilian exports of petroleum and natural gas were 21.3% of the total production in 2009, whereas 90.2% of the total production of iron ore was exported.

equipment sectors are strongly dependent on inter-industrial supply and stimulate production in other sectors. These data demonstrate the importance of these sectors and their ability to increase production in other sectors. In the upper-left quadrant, agricultural commodities, modern services, business services and utilities are the sectors with the largest inter-industrial demand dependence. These sectors present the lowest capacity to increase production in other sectors of the economy; they actually depend on the production of other sectors. This result is expected for the services sector. Moreover, traditional services are in the lower-left quadrant, which indicates the sector's lack of dynamism. Therefore, the growth rates of the economy would likely be lower if increases in income stimulated the production of these types of services.

Graph 1 - Hirschman-Rasmussen BL and FL indices – Average 2000-2009
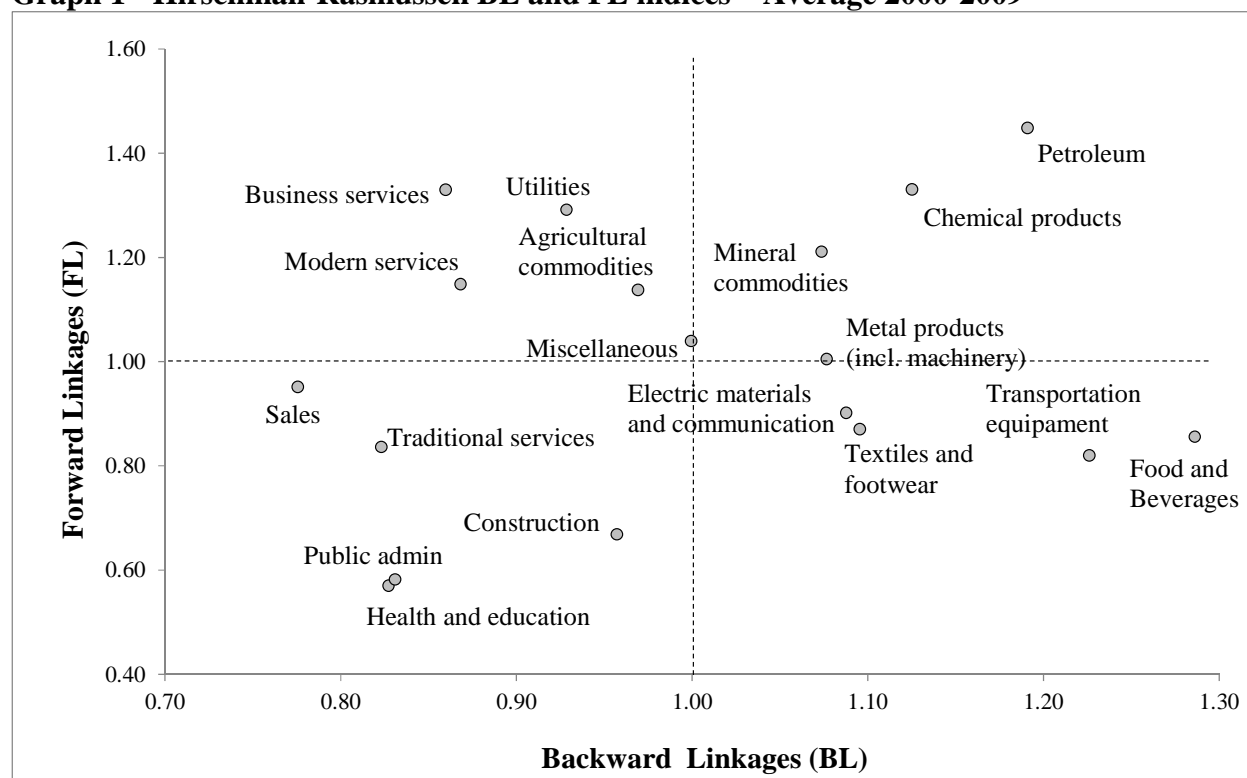
Source: Elaborated by the authors based on the estimated Brazilian input-output tables.

However, the Hirschman-Rasmussen index does not consider the size of sectors in the economy, which helps to identify key sectors. Thus, Table 1 (columns 7-10) includes these indices normalised by the sector size. The first index assesses the pure impact of a sector on its chain, and the second index measures the sector's capacity to supply inputs to the domestic industry. Food/beverages, traditional services, public admin, health/education, construction and transportation equipment occupy the first six positions of the BL indices. The food/beverages sector has the highest index because of the importance of its demand from other industrial complexes and its size compared with the other sectors. In addition, the transportation equipment sector's output has a rising pure impact and has demanded inputs from the other sectors of the economy over time. Moreover, traditional services and construction appear as sectors with a high demand from other sectors in the economy because of their relative importance to the economic structure. Services represent nearly two thirds of the Brazilian economy, and these two groups are the most relevant.

As expected, products with a lower degree of processing that are employed in the production of other goods exhibited relatively high FL indices. The transportation equipment and electrical materials/communications equipment sectors, whose degree of processing is higher and whose chain is closer to final goods, ranked 14th and 15th, respectively. Agricultural commodities, some services and

chemical products present high FL indices because they are important suppliers for the economy as a whole. Moreover, although mineral commodities have a low degree of processing, they are ranked only 8th. This position is due to the low significance of this sector as a domestic supplier because of the high volume of raw mineral exports.

5. Concluding remarks

Although the Brazilian development model adopted since the *Plano Real* in 1994 was able to guarantee price stabilisation, it failed to promote economic growth during the 1990s. The national economy resumed a growth path with improvements in external demand for Brazilian products only in the early 2000s. Given this joint process, most interpretations of the recent expansion of the Brazilian economy identified commodity production and its exports as the main drivers of this growth pattern.

To assess this phenomenon, this study analysed the abilities of various sectors to boost the Brazilian economy. Input-output matrices were used to quantify the potential of commodities, manufacturing and services to leverage demand from other sectors and to identify key input-supplying sectors. Agricultural and mineral commodities and non-tradable sectors exhibited little capacity to boost the economy. In addition to their low multipliers, BL indices for these sectors were low because their supply chains are not large. In contrast, the FL indices of the most modern and dynamic service sectors are high, and these sectors can stimulate general output when associated with manufacturing production, especially production that is more sophisticated and that demands high-value-added services.

Although it also falls under the commodity category, the petroleum sector has notably different characteristics than the other sectors. In addition to the relative importance of petroleum as a demand sector and thus as a booster of other supply chains, this sector is the leading supplier of inputs for the economy. The petroleum sector is a provider of inputs used for manufacturing, the main industrialised products produced by the chemical products sector and the synthetic materials produced by the apparel sector. The petroleum sector is also an indirect supplier of the transportation equipment and electrical materials/communications equipment sectors and several other industries. Thus, the contrasting behaviour of the petroleum sector compared to the other sectors clearly demonstrates the importance of adding value to commodities rather than simply exporting raw or semi-manufactured goods.

The analysis of multipliers and linkage indices also emphasised the importance of transportation equipment and food\beverages as sectors that are highly dependent on inter-industrial supply. These sectors have a high potential to turn final demand into production both within themselves and in their upstream supply chain. These results emphasise the importance of focusing development strategy on consolidating a production structure in which supply chains are organised so that final demand can boost the remainder of the economy.

Therefore, the analysis of the Brazilian production structure clearly showed that sectors related to manufactured products can boost the economy to a greater extent than other sectors due to their linkage effects on other sectors of the economy. Efforts to promote a dynamic production structure must be associated with a development strategy that considers comparative advantages in the economy while considering the advantages of a production structure oriented toward expanding manufacturing. Interpretations of the recent growth of Brazil's economy that explain it based on the expansion of "commoditised" and non-tradable sectors or on the country's comparative advantages limit the understanding of the complex factors that boost an economy. Therefore, a development strategy that guarantees high growth rates over the long term should recognise the importance of a productive structure oriented toward manufacturing, even if this sector is boosted by primary commodities, such as the petroleum industry.

References

BACHA, E. & BONELLI, R. (2005), Uma interpretaçãos das causas da desaceleração econômica do Brasil. Revista de Economia Política, v. 25, n. 3 (99), p.163-189, jul./set.

BARROS, J. R. M. & GOLDENSTEIN, L. (1997), Reestruturação Industrial e Reordenação Financeira: um novo balanço. Mimeo.

BELLUZZO, L. G. M. & ALMEIDA, J. G. (2002), Depois da Queda. Rio de Janeiro, RJ: Civilização Brasileira publishing house.

BONELLI, R. (2005). *Industrialização e desenvolvimento (notas e conjecturas com foco na experiência do Brasil).* Paper prepared for the Seminar "Industrialization, Deindustrialization and Development," sponsored by FIESP (Federation of Industries of the State of São Paulo) and IEDI (Institute for Studies for Industrial Development). São Paulo, SP, November 28, 2005.

BRESSER-PEREIRA, L.C. (2008), *The Dutch disease and its neutralization: a Ricardian approach. Revista de Economia Política*, v. 28, n. 1, pp. 47-71.

BRESSER-PEREIRA, L.C. (2009) *Developing Brazil: Overcoming the Failure of the Washington Consensus*, Boulder: Lynne Rienner Publishes.

BRESSER-PEREIRA, L.C. (2012), "Structuralist macroeconomics and the new developmentalism". *Revista de Economia Política*, v. 32, n. 3, pp. 347-366.

CARNEIRO, R. (2002), Desenvolvimento em Crise: a economia brasileira no último quarto do século XX. Campinas: UNICAMP, Institute of Economics; São Paulo: Editora UNESP publishing house, 2002.

CANUTO, O., CAVALLARI, M & REIS, J.G. (2013), *Brazilian Exports, climbing down a competitiveness cliff.* The World Bank. Poverty Reduction and Economic Management Network. January 2013.

CELLA, G. (1984), *The input-output measurement of interindustry linkages.* Oxford Bulletin of Economic and Statistics, v. 46, pp. 73-84, 1984.

CHAYANOV, A.V. (1966) The theory of peasant economy, in D. Thorner, B. Kerblay and R.E.F. Smith, eds. Homewood, IL: Richard D. Irwin, Inc.

CHENERY, H.; SHERMAN, R.; MOSHE, S. (1986), *Industrialization and growth.* Oxford University Press, published for the World Bank, 1986.

CLEMENTS, B.J. (1990), *On the decomposition and normalization of interindustry linkages*. Economics Letters, v. 33, n. 4, pp. 337-340, Aug. 1990.

CORDEN, W. M.; NEARY, J. P. (1982). *Booming Sector and De-Industrialisation in a Small Open Economy*, The Economic Journal, Vol. 92, No. 368. (Dec., 1982), pp. 825-848.

CORNWALL, J. (1977), *Modern Capitalism. It's Growth and Transformation,* New York, St. Martin's Press.

DASGUPTA, S. & SINGH, A, (2006), *Manufacturing, Services and Premature Deindustrialization in Developing Countries: A Kaldorian Analysis.* Working Papers RP2006/49, World Institute for Development Economic Research (UNU-WIDER).

DIXON, R.; THIRLWALL, A. P. (1975), *A model of regional growth-rate differences on Kaldorian lines*. Oxford Economic Papers.

FAGERBERG, J. & B. VERSPAGEN (1999). *Modern Capitalism in the 1970s and 1980s*. , table 9.1, Iin M. Setterfield ed., Growth, Employment and Inflation, Houndmills, Basingstoke, MacMillan.

FRANCO, G. (1998), *A inserção externa e o desenvolvimento*. Revista de Economia Política, v. 18, n. 3, Jul./Sept. 1998.

FURTADO, C. (1961), *Desenvolvimento e Subdesenvolvimento* (3rd ed.). Rio de Janeiro, RJ: Editora Fundo de Cultura publishing house, 1965.

FURTADO, C. (1961), Elementos de uma teoria do subdesenvolvimento. , 1961, I.i.n: Bielschowsky, Ricardo, org., *Cinquenta anos de pensamento na CEPAL*, Ed. Record publishing house, vol. 1, 2000.

GUILHOTO, J. (2009). *Análise de Insumo-Produto: teoria, fundamentos e aplicações*. Book in preparation. Department of Economics, FEA-USP.

GUILHOTO, J.J.M. & U.A. SESSO FILHO. (2005), "Estimação da Matriz Insumo-Produto a Partir de Dados Preliminares das Contas Nacionais". *Economia Aplicada*. Vol. 9. 18, n. 2, pp. 277-299. April-June, 2005.

GUILHOTO, J.J.M.; SONIS, M.; HEWINGS, G.J.D. (1995), Linkages and multipliers in a multiregional framework: integrations of alternative approaches. Illinois: REAL, 1996. 19 pp. (Discussion Paper, 8)

GUILHOTO, J.J.M.; SONIS, M.; HEWINGS, G.J.D.; MARTINS, E.B. (1994), Índices de ligações e setores-chave na economia brasileira: 1959/80. Pesquisa e Planejamento Econômico, v. 2, n. 24, pp. 287-314, Aug. 1994.

HIRSCHMAN, A.O. (1958),. *The Strategy of Economic Development*. New Haven, TC: Yale University Press.

KALDOR, N. (1966), *Causes of the slow rate of economic growth in the United Kingdom*, 1989. In: TARGETTI, F.; THIRLWALL, A. P. (Ed.).*The Essential Kaldor*. Holmes & Meier Publishers, New York, 1989.

KALDOR, N. (1981), *The role of increasing returns, technical progress and cumulative causation in the theory of international trade and economic growth*. Economie Appliquée, vol. 34(6), pp. 593-617, 1981.

LAPLANE, M. & SARTI, F. (2006), Prometeu Acorrentado: o Brasil na indústria mundial no início do século XXI. 2006. In: CARNEIRO, Ricardo (org.). *A Supremacia dos mercados e a política econômica do governo Lula*. São Paulo: Editora UNESP publishing house, 2006.

LEONTIEF, W. (1951). *The Structure of the American Economy*. Second Edition. New York: Oxford University Press.

LEWIS, ARTHUR W. (1954), *Economic Development with Unlimited Supply of Labor, 1958*. In AGARWALA AND SINGH, orgs. *The Economics of Underdevelopment*. New York: Oxford University Press, 1958.

LIPTON, M. (1968), 'Strategy for agriculture: urban bias and rural planning', in: P. Streeten and M. Lipton, eds. The crisis of Indian planning. London: Oxford University Press

LODEFALK, M. (2010), *Servicification of Manufacturing - Evidence from Swedish Firm and Enterprise Group Level Data*, Örebro University. Swedish Business School. Working Paper 3/2010.

MARCONI, N. and ROCHA, M. (2012), *Taxa de câmbio, comércio exterior e desindustrialização precoce - o caso brasileiro.* Economia e Sociedade (UNICAMP. Impresso), v. 21, pp. 853-888, 2012.

MCCOMBIE, J. S. L. & THIRLWALL, Anthony A. P. (1994a), *The Balance-of-Payment constraint as an explanation of international growth rates differences*. New York, SI, Martin's Press,1994.

MCCOMBIE, J. S. L. &; THIRLWALL, A. P. (1994b), *Economic growth and the balance-of-payments constraints*. New York: ST. Martin's Press.

MILLER, R. E & BLAIR P.D. (2009), *Input-Output Analysis: Foundations and Extensions*. 2nd. Edition. Cambrige: Cambridge University Press.

MORENO-BRID, J. (2003), *Capital flows, interests payments and the balance-of-payments constrained growth model: a theoretical and empirical analysis*. Metroeconomica, v. 54, n. 2.

NORDÅS, H. K. and KIM, Y. (2013), "The Role of Services for Competitiveness in Manufacturing", *OECD Trade Policy Papers*, No. 148, OECD Publishing. http://dx.doi.org/10.1787/5k484xb7cx6b-en.

PALMA, G. (2005), *Four sources of 'de-industrialisation' and a new concept of the dutch disease*. In: OCAMPO, J. A. (Org.). *Beyond reforms:structural dynamics and macroeconomic vulnerability*. Stanford University Press and World Bank.

PRATES, D. M. (2006), A inserção externa da economia brasileira no governo Lula, in: CARNEIRO, R. (Org.). *A Supremacia dos Mercados e a Política Econômica do Governo Lula*. São Paulo: Editora UNESP publishing house, 2006.

PRATES, D. M. (2007), A alta recente dos preços das commodities. Revista de Economia Política [online]. 2007, vol. 27, n. 3, pp. 323-344.

PREBISCH, R. (1949), O desenvolvimento econômico da América Latina e seus principais problemas, 1949, in BIELSCHOWSKY, R., org. *Cinquenta anos de pensamento na CEPAL*, Ed. Record publishing house, vol. 1, 2000.

PREBISCH, R. (1986), *El desarrollo de la América Latina y algunos de sus principales problemas*, in: BIELSCHOWSKY, R. Cinqüenta años de pensamiento en la Cepal: selected texts. Santiago de Chile: Cepal/Fondo de Cultura, 1998.

RASMUSSEN, P. (1956), *Studies in Intersectoral Relations*. Amsterdam: North Holland.

ROCHA, I. L. (2011), Reestruturação industrial no Brasil: uma análise da dinámica comercial e produtiva da economía. Campinas, SP: Master's Degree Dissertation, 2011.

RODRIK, D. (2007), *Industrial development: Some stylized facts and policy directions*. In*: Industrial Development for the 21st Century: Sustainable Development Perspectives*. Department of Economic and Social Affairs Publications. New York: United Nations, 2007.

ROSENSTEIN-RODAN, P. 54, N. (1943), *Problems of Industrialization in Eastern Europe and South-Eastern Europe*. *Economic Journal* 53, June 1943.

ROSTOW, W. W. (1956), *The take-off into self-sustained growth. The Economic Journal*, v. 66, n. 261, pp. 25-48, Mar, 1956.

ROWTHORN, R. & COUTTS (2004), "Deindustrialization and the Balance of Payments in Advanced Economies", *Cambridge Journal of Economics*, 28(5), 767:90.

SCHULTZ, T.W. (1964) Transforming traditional agriculture, New Haven, CT: Yale University Press.

SINGER, H. W. (1950). *The distribution of gains between investing and borrowing countries*. American Economic Review, 40 (2), 473-485.

STALLINGS, B. & PERES, W. (2000), *Crecimiento, empleo y equidad. El impacto de las reformas económicas en América Latina y el Caribe*. Santiago de Chile: Fondo de Cultura Económica/Cepal.

SZIRMAI, A. (2009). Industrialisation as an Engine of Growth in Developing Countries, 1950-2005, UNU-MERIT working paper, 2009-10, February, 2009).

SZIRMAI, A. (2012), *Industrialisation as an engine of growth in developing countries, 1950-2005. Structural Change and Economic Dynamics*. Vol. 12, n. 4, Dec. 2012.

TAVARES, M. C. (1998), "Ciclo e crise: o movimento recente da industrialização brasileira". Campinas, Institute of Economics, 1998.

THIRLWALL, A. P. & HUSSEIN, M. (1982), *The balance of payments constraint, capital flows and growth rates differences between developing countries*. Oxford Economic Paper, n. 10, pp. 498-509.

THIRLWALL, A. P. (1979), *The Balance of Payments Constraint as an Explanation of International Growth Rate Differences*. 1979.

VERDOORN, P. J. (1949), *On the factors determining the growth of labour productivity*. In: PASINETTI, L. (Ed.). Italian Economic Papers, Oxford University Press, pp. 45-53.

WILLIAMSON, J. (1989*), What Washington mean by policy reform in a conference held by the Institute for International Economics in November, 1989*. Published as the opening chapter in the conference volume The progress of policy reform in Latin America, 1990.

Appendix 1 - Translator of types of commodities, manufacturing and services

Agricultural Commodities	Food and beverages
Agriculture, forestry, extractive products	Food and beverages
Livestock and fishing activities	**Electric Materials and Communication Equipment**
Tobacco products	Household appliances
Wood products - excluding furniture	Office machines and IT equipment
Pulp and paper products	Electrical machines, appliances and equipment
Alcohol	Electronic materials and communications equipment
Petroleum	Medical-hospital equipment/instruments for measurement and optical purposes
Petroleum refining and coking	
Oil and natural gas	**Transportation equipment**
Mineral Commodities	Cars, vans and off-road vehicles
Manufacture of steel and steel products	Trucks and buses
Iron ore	Parts and accessories for motor vehicles
Metallurgy of non-ferrous metals	Other transportation equipment
Other extractive products	**Construction**
Cement	Construction
Other non-metallic minerals	**Sales**
Textiles and footwear	Sales
Textiles	**Modern Services**
Articles of apparel and accessories	Information Technology Services
Leather products and footwear	Financial Intermediation
Miscellaneous	**Business Services**
Furniture items and products of different industries	Business Services
Newspapers, magazines, CDs	**Education and Health**
Chemical Products	Commercial Education
Manufacture of resins and elastomers	Commercial Health
Pharmaceutical products	Public Education
Agrochemicals	Public Health
Perfumes, hygiene and cleaning products	**Traditional Services**
Paints, varnishes, enamels and lacquers	Transport and Post Activities
Various chemical products and preparations	Real Estate Activities
Chemical products	Repair of Household Goods
Rubber and plastic items	Hotels and Restaurants
Metallurgy (incl. Machinery)	Household Services
Metal products - except machinery and equipment	Other Community, Social and Personal Services
Machines and equipment, including maintenance and repairs	**Public Admin**
	Public Admin and Compulsory Social Security