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The Impact of the Brazil-China Trade Relation on the Brazilian Manufacturing Sector

A Brazília és Kína közötti kereskedelmi kapcsolat hatása a brazil gyártási szektorra

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Abstract: The present paper aimed to review the growing trade relation between Brazil and China, and to examine China's impact on the Brazilian manufacturing sector. The study tried to distinguish the direct and indirect impacts of China on the aforementioned sector by applying a matrix that had been formerly developed by Kaplinsky and Messner (2008) and Jenkins (2012); then attempted to estimate the size of correlation between that sector and its trade with China and the Chinese growth. The analysis on the Brazilian industrial trend, export and import structure, on China's effect on the world commodities' prices, and on the Brazilian real exchange rate showed that the Brazilian manufacturing sector suffered quite much, both directly and indirectly due to the Brazil-China trade relation. In overall, the two countries' trade relation since 2000 has led to the deindustrialisation and the primarisation of the Brazilian exports that may have negative consequences in the long-term development.

Összefoglaló: *A jelen cikk célja az volt, hogy áttekintse a Brazília és Kína közötti növekvő kereskedelmi kapcsolatot, és megvizsgálja Kínának a brazil gyártási szektorra tett hatását. A tanulmány a korábban Kaplinsky és Messner (2008), valamint Jenkins (2012) által kifejlesztett mátrixot alkalmazta annak érdekében, hogy Kínának a fent említett szektorra tett közvetett és közvetlen hatásait megkülönböztesse egymástól; majd e szektor és a Kínával való kereskedelem, valamint a kínai növekedés közötti korreláció mértékét becsülte meg. Az elemzés, amely a brazil ipari trendre, export- és importszerkezetre, a Kínának a nyersanyagok világpiaci áraira gyakorolt hatására és a brazil reálárfolyamra vonatkozott, rávilágított arra, hogy a brazil gyártási szektor közvetett és közvetlen módon is elszenvedte a Brazília és Kína közötti kereskedelmi kapcsolatot. Összességében a két ország 2000 óta fennálló kereskedelmi kapcsolata vezetett a brazil export deindusztralizációjához és primarizációjához, amely negatív következményekkel járhat a hosszú távú fejlődés szempontjából.*

Introduction

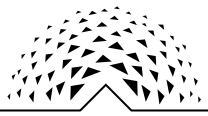
The diplomatic relationship between the two countries started in 1974 under the military government, however, that relation was limited until 1990s.[1] In 1993, China accepted Brazil as a "Strategic Partner", due to what, Brazil became the first Latin American country to receive this designation from China.[2] Later on in 2001, China received the WTO membership and the two countries joined their forces in the BRICS integration, since when the trade relation between them has been boosted. The five-letter BRICS acronym considered the candidates to play a major role in an international scenario in the near future.[3] Consequently,

1 Baumann, 2009.
2 Jenkins, 2012, p. 22.
3 Baumann, 2009.

China could become the world's second largest economy and biggest single contributor to the global growth.[4] Chinese GDP overtook the German GDP in 2007, and the Japanese in 2009.[5] In terms of gross income per capita in China, it has increased twenty-fold between 1979 and 2012, and as a result, China has transformed from a low-income to an upper-middle-income country.[6] Accordingly, China lifted 800 million people out of poverty until 2014, and its population living below the international poverty line decreased substantially from 88 percent in 1981 to 6.5 percent in 2012.[7] Therefore, the Chinese average annual GDP growth has been around 9 percent in the last three decades, while it reached a similar level to the one in Zambia in 1978.[8] Thus trade liberalisation has been a fundamental part in China's economic reform process, and the WTO membership symbolises China's trade openness at the international level. Moreover, China's inward and outward FDI flows have increased significantly since 2003, where its stock of inward FDI increased more than six-fold between 2001 and 2015, where the Chinese government played an important role in this international expansion.[9] Furthermore, Chinese firms started a "going global" strategy and their outward FDI grew substantially with the state support. However, since the financial crisis of 2008, the Chinese economy has slowed down that led to the "New normal" period with the slow growth of world trade and the rebalance of economy in favor of domestic consumption rather than investment and exports.[10] Those rapid emergence and growth of China over the past four decades had major effects in the Latin American countries (LACs), especially in Brazil, as it is the largest Latin American economy and the biggest exporter to China in the region.

In 2012, the two countries stepped forward their trade relation as they announced their "Comprehensive Strategic Partnership".[11] Thus they are becoming more and more integrated with each other in terms of trade. Although China saw Brazil as a competitor in the early 2000s, since then its bilateral trade with Brazil has been drastically increasing, while Brazil's export share to U.S. and EU region has decreased, so China could finally see Brazil in positive terms.[12] Both countries benefit from the trade due to their comparative advantages and specialisation: Brazil has become more specialised in commodities, whereas China has become more specialised in manufactures.[13] However, this can give more opportunities or threats in the Brazilian economy. There is a long lasting debate in the literature if China's impact on Brazil has more positive or negative effects, and more complementary or competitive effects.

4 *World Bank*, 2018.
5 Jenkins, 2018, p. 2.
6 *Ibid.*
7 *Ibid.*
8 *World Economic Forum,* 2016.
9 Jenkins, 2018.
10 *Ibid.*
11 Jenkins, 2015, p. 43.
12 Walley and Medianu, 2012.
13 Ferrari, Biage and Da Silva, 2011, p. 966.



Most of the literature on this topic only focus on the competition in third markets, researching how Brazil has lost its manufacturing export share to China in third markets such as the U.S., Europe and other Latin American countries. The share of Brazilian exports destined to the U.S., Europe and Asia (except China) declined between 1994 and 2007, where particularly the high technology group of exports has lost its share to China in international markets.[14] The Industrial Federation of the State of Sao Paulo (FIESP) estimated the Chinese competition in third markets, and concluded that Brazil had lost exports of $12.6 billion to China in the U.S., the EU and Argentina between 2004 and 2009. Jenkins in 2014 calculated the Brazilian market share loss in third markets to China, and revealed that Brazil had been losing its customers abroad to China in regard of all types of manufactures.[15] He highlighted that there had been a large loss of low technology products, but in a number of markets, particularly in Argentina, Mexico, Venezuela, Colombia and the U.S., in the period of 2007–2010, there had been significant losses in high technology products too.[16]

Therefore, the effects of the competition in the Brazilian domestic manufacturing market have been relatively ignored in the literature. Thus, this paper tries to fill in this gap by studying China's impact on the Brazilian domestic manufacturing sector, and to determine whether it leads to the deindustrialisation in Brazil. Studies on this topic mainly cover the period up to 2001, when China entered the WTO, or to the 2008 financial crisis, or (the latest study) to 2012. Thus this paper includes updated data on the period up to 2016 investigating the following research questions: *"What are the direct and indirect effects of the Brazil-China trade relation on the Brazilian manufacturing sector?" and "Is the Brazil-China trade relation causing deindustrialisation in Brazil?"*.

The paper is organised as follows. Section 2 summarises the related literature. Section 3 provides an analysis for China's direct and indirect impact on the Brazilian manufacturing sector in terms of trade. Section 4 shows the results of the econometric analysis. The fifth, the last section concludes.

Industrialisation, Deindustrialisation and Primarisation

According to Jenkins, there are two types of economists who assume the role of industrialisation in economic development:[17] (a) orthodox economists emphasise that comparative advantage helps the countries to produce more of that product, and they can get advantage from whatever the country specialises in; (b) on the other hand, heterodox economists have the perspective that manufacturing has an important role in the economic

14 Dos Santos and Zignago, 2010.
15 Jenkins, 2014.
16 *Ibid.*, p. 414.
17 Jenkins, 2015.

development. By producing manufactured goods, industrialisation takes place in the economy, and adds value and capital accumulation in that economy.[18] Tregenna also mentioned that industrialisation had positive consequences in the society and supported the improvement of social structure and social class.[19] Therefore, the growth in manufacturing is the most important ingredient for the economies of scale, technological change and innovation. Then manufacturing growth influences the other sectors of the economy, and soon supports the whole economy.

In Latin America, structuralists designed a heterodox perspective that favored the manufacturing sector rather than the primary products. Manufacturing plays an important role in the economic development and is the fundamental base of technological growth.[20] Dependency theorists linked the economic growth to the core-periphery relation in the way that the industrial production was the core, and the primary commodity was the periphery.[21] If periphery on industrialisation happens, it leads to the new dependence, in which the country becomes dependent on the primary commodities. Latin American structuralists had numerous arguments that were in favor of the industrialisation process such as: learning by doing brings economies of scale, manufacturing sector is the main driver behind economic growth, and most importantly, industrialisation is the main gateway to technological advancement.[22]

Traditionally, *deindustrialisation* is termed as a decline in manufacturing in terms of total employment.[23] But this is a limited perspective and Tregenna in 2008 developed this concept by analysing the changes in the manufacturing employment and suggested that deindustrialisation should have been stated in terms of fall in both, the share of manufacturing in total employment and the share of manufacturing in GDP. Deindustrialisation in Latin America is mainly about a shift from the manufacturing to the primary commodities' production. It has a negative effect on the economic growth because manufacturing is the process of accumulation by increasing the value of production.[24]

Deindustrialisation is not necessarily a negative concept, but rather a byproduct of economic progress: the GDP relies less on the manufacturing and more on the service.[25] In contrast, the "early deindustrialisation" is a negative phenomenon that refers to when the deindustrialisation happens before the service sector practices a certain technological advance to increase the manufacturing productivity or before the per capita income reaches high enough of U.S.$25,000.00.

18 Reinert, 2007.
19 Tregenna, 2013.
20 Hirschman, 1958.
21 Cardoso and Faletto, 1979.
22 *Ibid.*
23 Tregenna, 2008, p. 433.
24 Tregenna, 2014.
25 Callegari, Massaroli Melo and Carvalho, 2018, p. 1327.

In 2015, Jenkins highlighted numerous causes for the deindustrialisation to appear.[26] Firstly, when the income elasticity of demand for manufacturers and services are differentiating. Secondly, the differential between the growth of productivity in manufacturing and other sectors can affect the output and the employment of that particular sector at the same time, meaning that faster productivity growth leads to less employment. It may also lead to a decline in the relative price of goods manufactured because of the price measurements. Thirdly, the change in the trade balance of the country can also cause deindustrialisation. Declining surplus or increased deficit in trade in manufactures also contributes to that process. Lastly, there is the outsourcing of activities by manufacturing companies. This creates the statistical illusion of deindustrialisation in which activities that were previously carried out in-house and therefore classified as "manufacturing" outsourced to specialised suppliers in the service sector and now appear as "service" activities without any real change in their nature.[27]

Deindustrialisation is often connected with *primarisation* or re-primarisation, in which concept of primarisation are the reliance on primary commodities and its exports.[28] When a country shifts from manufacturing to primary commodities due to the discovery of a new natural resource, to a new commodity boom, or to a change in economic and trade policy, it is termed as "Dutch disease".[29] Then Dutch disease effect leads the country to have a one-sided economy, where the main profit comes from natural resource-based activities. Dutch disease is connected with commodity boom, in a nutshell it refers to giving too much attention to one particular sector, whether to its primary products or commodities, leads to a weak economic output and performance and it also might lead to recession.

Therefore, the concerns about deindustrialisation and primarisation mostly came from the heterodox and the radical political economists. From the heterodox point of view, deindustrialisation would have a negative effect on economic growth.[30] Resources are moved to the sectors where they would have less potential for innovation and cumulative productivity. Displacement of labor, in regard to deindustrialisation, might lead to unemployment or underemployment. As far as exports are concerned, primarisation results in disadvantageous specialisation leading to a greater volatility of exports and balance-of-payments problems. Therefore, both the deindustrialisation and the primarisation have significant consequences on the society. Their consequences were distinguished by Jenkins: the deindustrialisation threatens the domestic industrial capital market and changes the nature of activities by shifting from the manufacturing to the other sector, while the primarisation is likely to strengthen the position of landlords or owners.

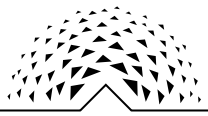
26 Jenkins, 2015.
27 *Ibid.*
28 *Ibid.*, p. 45.
29 Palma, 2005.
30 Jenkins, 2015.

Deindustrialisation in Brazil

The Brazilian economy has made a significant achievement since 2000. Brazil's GDP growth was around 3-4 percent annually between 2000 and 2016.[31] The Brazilian export increased almost four-fold, and the import boosted 2.5-fold during the period of 2002-2012, hence, the country could experienced trade surplus through the most times of the period.[32] People living under international poverty line of $1.9 per day decreased from 22 million in 2002, which counted for 12.3 percent of the population, to 9.7 million in 2013 that counted for 4.8 percent of the population.[33] However, this growth and achievement is not maintainable in the long-term and the Brazilian trade structure has shifted considerably from the manufacturing to the primary production since 1990s. Over the past two decades, the Brazilian manufacturing share in the total employment and GDP have decreased considerably, while the reliance on primary commodities has increased. That leads to primarisation and deindustrialisation, and brings fear for the future of the manufacturing sector, especially in textile industry, machinery and equipment, electrical and electronic production, and toy industry.[34] The Brazilian economy also experienced an "early deindustrialisation" process, in which the Brazilian industrial sector's share in the total employment and GDP fell without an increase in the service sector.[35] Brazil ranks at the lowest income growth rates in Latin America, and the share of its manufacturing industry in GDP has been falling, which decreased by 4.4 percent from 2004 to 2014.[36] The Brazilian imports are mostly for the country's domestic consumption, not for adding value to the exports with backward participation. This low usage of imported inputs in the country's export is known as backward participation, and the Brazilian contribution in the global value chain can be characterised by an increasing export in basic goods and by an import in medium-high technology goods.[37]

This Brazilian deindustrialisation process over the past decades has generally connected to the Chinese growth and competition, and its impact on the Brazilian industry has become substantial only since the mid-2000s.[38] Jenkins in 2012 found that China and Brazil's trade had both direct and indirect effects and their bilateral trade flows were positive, however, it was dependent on the Chinese demand for commodities. There were also winners and losers in Brazil as a result of China's growth: the winners were mainly the primary commodities' producers, and the losers were mainly in the manufacturing

31 *World Bank,* 2017.
32 Jenkins, 2015, p. 47.
33 Forbes, 2016.
34 Jenkins, 2015, p. 47.
35 Callegari, Massaroli Melo and Carvalho, 2018, p. 1322.
36 *Ibid*, p. 1328.
37 *Ibid.,* p. 1322.
38 Jenkins, 2012.



sectors. Similar findings can be seen in Baumann's study which revealed that the Brazilian economic relation to China brought both challenges and opportunities in the economy.[39]

In the literature, there are long lasting debates on China's impact on Brazil between the complementary and the competitive effects. A result of panel data analysis of twenty Brazilian trading partners within the period of 1992-2007 found that China's influence did not cause a reduction in Brazil's exports.[40] Economic relationship between China and Brazil focusing on bilateral trade, FDI flows and policy coordination including trade agreements, negotiations and antidumping over a 10-year period showed that the China-Brazil economic and political relationship would be much more complementary, and their bilateral trade and FDIs were increasing fast.[41] The expanding relationship between China and Brazil serves a trade strategy to diversify worldwide, where the countries have a balanced and sustainable relationship that have more complementary effects.[42] Furthermore, the degree of competition that Brazilian exporters face from China is declining.[43] It has been argued that the products exported by Brazil tended to be of higher quality than the Chinese exports – implying that they did not compete directly.[44]

On the other hand, there are some researches that found China's impact on Brazil to rather have competitive effects. China's growth impact on Brazil, Chile and Peru during the commodity boom between 2001 and 2008 was studied by a BPC growth model, and the results showed that those three countries faced income elasticity of demand for imports, and that the BPC played a negative role in the economic growth. Thus they should diversify their exports, improve intraregional trade, and increase export structure; otherwise they will face high income elasticity for imports.[45] Therefore, Moreira found these negative effects on the Argentinean and Brazilian as well as on the Mexican exports to the United States and indicated that the annual loss of world market share by Latin American countries to China had increased over time, particularly since 1999.[46] Moreover, Jenkins cited the research of Machada and Ferraz that studied the competition between Brazil and China in the EU market during the period up to 2001 and found that Brazil lost its market share there to China.[47] However, since then the competition has increased and Brazil has been facing a competitive threat from China, especially in the manufacturing sector leading to the deindustrialisation process.

39 Baumann, 2009.
40 Ferrari, Biage and Da Silva, 2011.
41 Walley and Medianu, 2012.
42 Haibin, 2010.
43 Jenkins, 2014.
44 Dos Santos and Zignago, 2010.
45 Murakami and Hernández, 2018.
46 Moreira, 2007.
47 Jenkins, 2012.

Analytical Approach and Data Set

This paper is analysing the direct and indirect effects of China on the Brazilian manufacturing sector. Therefore, the matrix developed by Kaplinsky and Messner in 2008 and by Jenkins in 2012 is used to distinguish the effects.

This matrix gives a well-arranged framework that separates not only the direct and indirect impacts, but also the complementary and competitive effects of China on Brazil. Direct effects are the result of trade and FDI between the two countries, indirect effects are the outcome of how China influences indirectly Brazil through the world growth, international finance and global commodity prices.[48] Complementary and competitive effects are studied in a broader term of six channels including trade, FDI, finance, global governance, migration and environment.[49] This paper uses this framework to evaluate the direct and indirect effects of China on the Brazilian manufacturing sector, and aims to answer the research question: "What are the direct and indirect effects of the Brazil-China trade relation on the Brazilian manufacturing sector?". Based on Jenkins' and Kaplinsky and Messner's work, this paper will cover a detailed analysis of the Brazilian exports to and imports from China, and the Chinese foreign direct investments in Brazil for direct effects, while for indirect effects, it will evaluate how China influences world commodity prices that effects the Brazilian real exchange rate appreciation and leads to primarisation and deindustrialisation. The period of the study is between 2000 and 2016, the data in the evaluation are mainly collected from World Bank annual database, WITS World Bank Database, OEC Database and China-Brazil Business Council annual reports.

Figure 1
Matrix for Analysing the Effects of China
on the Brazilian Manufacturing Sector[50]

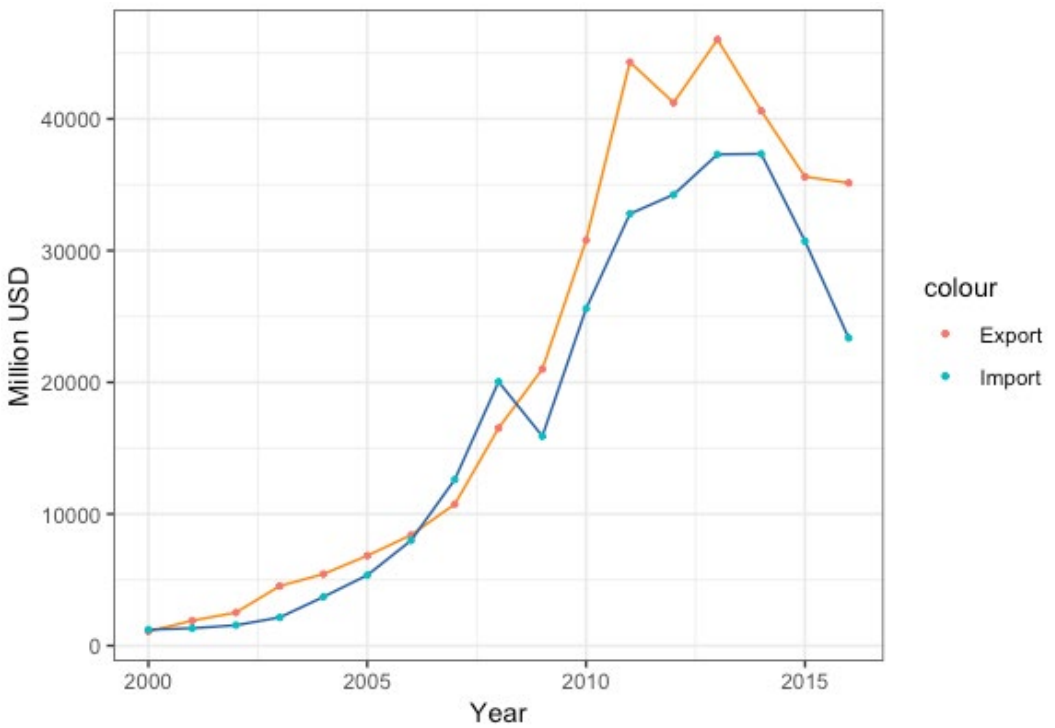
	Complementary effects	Competitive effects
Direct effects		
Indirect effects		

48 Jenkins, 2012.
49 Kaplinsky and Messner, 2008.
50 Own edition, 2019.

Direct Impact – Trade between Brazil and China

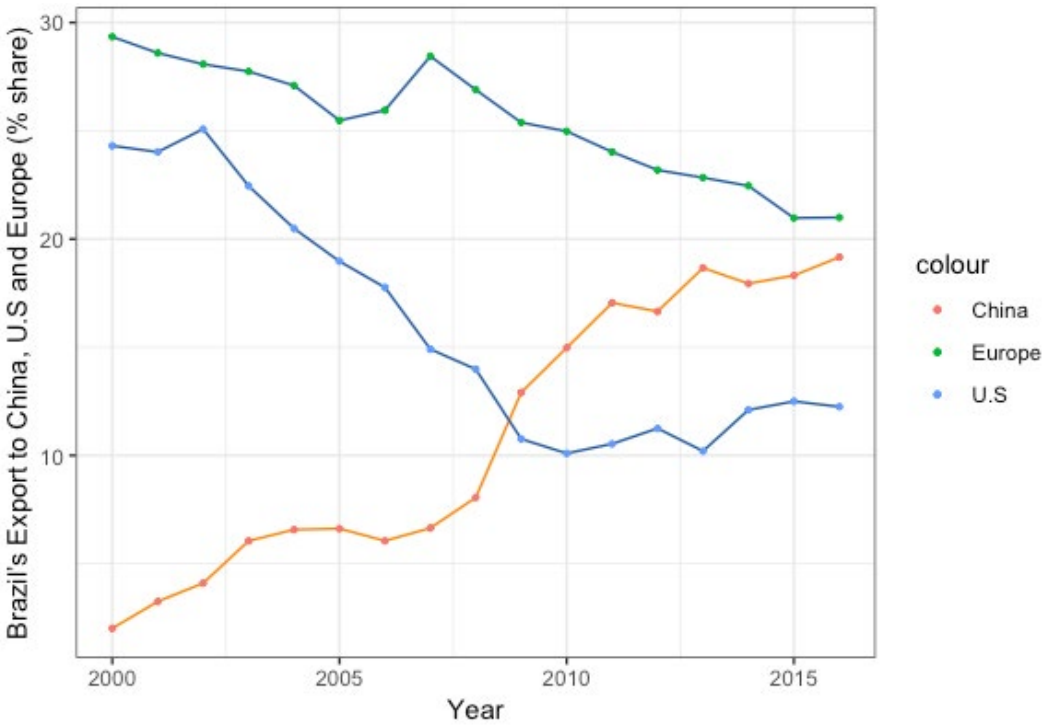
Since 2000, the trade between Brazil and China has been increasing dramatically. Figure 2 shows that the trade trend rapidly grew between 2000 and 2016. The gap between the Brazilian export to China and the import from China has been widening since 2000, meaning that Brazil exports much more than it imports. China's share in the Brazilian exports grew significantly from around 2 percent in 2000 to almost 20 percent in 2016 (Figure 3). Therefore, China has become Brazil's most important export destination, while the share of U.S. and Europe has decreased sharply. One possible explanation of this export increase to China is the accession of China to WTO in 2001 which lifted the Chinese integration in the global trade. Later on, the two countries joined their forces in the BRICS integration which enhanced the trade relation between them. Consequently, the Brazilian import from China boosted from 2002, and grew eighteen-fold between 2000 and 2016. Thus upon entering the WTO, China's access to the Brazilian market improved significantly.[51]

Figure 2
Brazilian Trade with China,
2000-2016



51 Jenkins, 2012, p. 25.

Figure 3
Brazil's Export to China, U.S. and Europe (% share), 2000-2016[52]



Brazilian Exports to China

The Brazilian export structure to China has dramatically changed since 1990s. The Brazilian exports to China increased more than thirty-one-fold between 2000 and 2016. Brazil's exports of raw materials to China increased four times, accounting for more than 80 percent of Brazilian total exports in 2016 (Table 1). In 1990s, the Brazilian exports to China mainly consisted of manufactures, accounting for 60 percent, while this share decreased significantly to only 8 percent in 2010.[53] Since then, it has still remained at the same percentage. Thus, the Brazilian export to China shifted drastically from the manufacturing to the primary commodities (unmanufactured products). The proportion of Brazilian manufacturing exports to China has been decreasing since 2004 (Figure 4). In value terms, manufacturing exports from Brazil to China have increased from US$1.2 billion in 2004 to US$2.8 billion in 2016. On the other hand, manufacturing exports from China to Brazil have boosted significantly from US$3 billion to US$21 billion, which is the seven-fold increase, during the same period. Thus, it is clear that the trade relation between Brazil and China has had a negative impact on the Brazilian manufacturing sector.

52 Own edition *OEC Database* (2000-2016), 2019.
53 Walley and Medianu, 2012, p. 708.

Figure 4
Brazilian Exports to China by Product Group, 2000-2016[54]

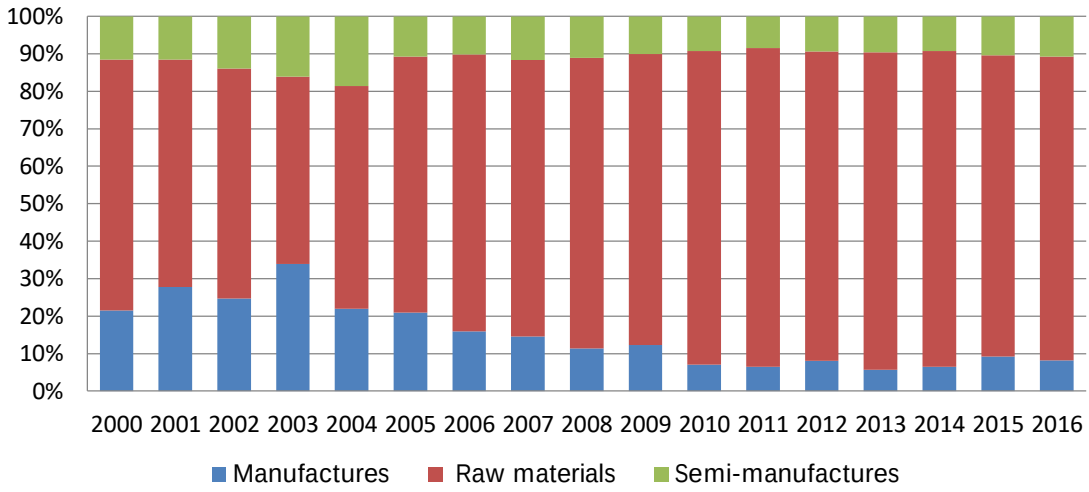


Table 1 also shows a very different structure for the Brazilian export to China compared to that of the ROW. Brazil's raw material export to countries other than China is around 30 percent, and its export of intermediate goods account for 33 percent. Share of exports of capital goods and consumer goods were much higher than that of Brazil's export to China.

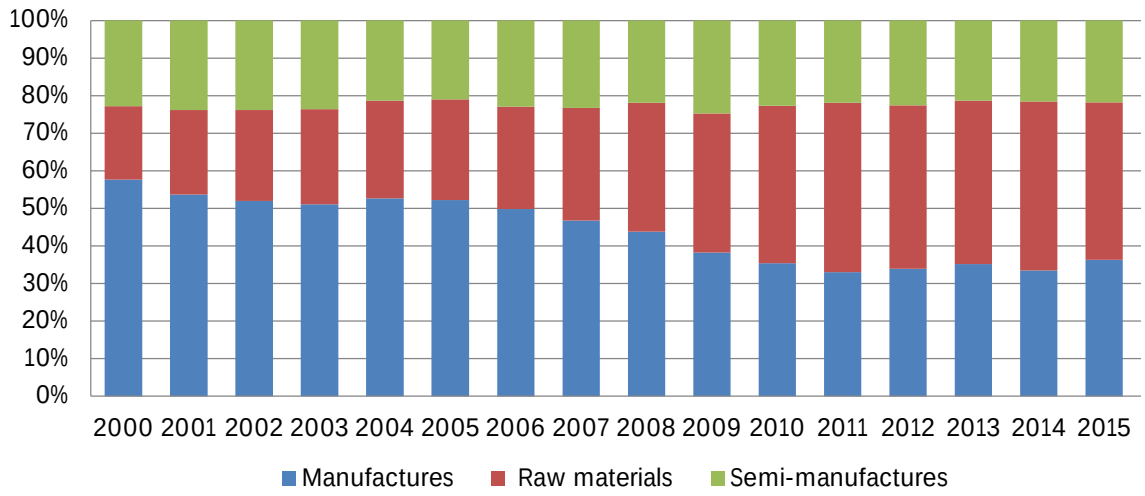
Table 1
Composition of Brazilian Exports to China and ROW
(% share)[55]

	Brazilian exports to China			To ROW
	1990	2000	2016	2016
Raw materials	19.25	66.99	81.04	30.18
Intermediate goods	77.57	22.05	15.16	33.39
Capital goods	1.98	8.23	3.14	19.78
Consumer goods	1.19	2.7	0.6	16.65

54 Own edition based on *WITS World Bank* Database (2000-2016), 2019
55 Own edition based on *WITS World Bank Database* (2000-2016), 2019.

Figure 5 shows the Brazilian export to rest of the world, where manufacturing products and semi-manufacturing goods accounted for around 40 percent and 20 percent, respectively, in 2016. Therefore, raw material exports accounted for around 40 percent of its total export. In terms of the Brazilian exporting products at technological levels, high technological products accounted for only 2.4 percent of its exports to China, and 7.6 percent of its exports to the rest of the world (Table 2).[56] This low innovation and weak technological performance have been the issue until now. Gallegari, Massaroli Melo and Carvalho in 2018 found that the Brazilian industry had not developed its technological competences and had showed a low appearance in the world exports of medium-high technology intensive sectors: the Brazilian share of world exports in terms of components for electric and electronic goods was around 0.1 percent and the share of transport equipment and machinery was 0.5 percent in 2015, which were lower than that of other developing economies.[57]

Figure 5
Brazilian Exports to ROW by Product Group, 2000-2016[58]



The Brazilian main exporting products to China were concentrated only on few primary commodities: soybeans, iron ore, crude petroleum and wood pulp. Mainly exports of soybeans, iron ore and crude petroleum consisted more than 70 percent of the Brazilian total export to China in 2016 (Table 2). The Brazilian soybeans export increased nine times between 2000 and 2016. China is the major destination to export, and China's soybean import share from Brazil increased from 16 percent in 2000 to 75 percent in 2016. It can be explained by that China's consumption of soybeans increased significantly and the tariff of soybeans deducted, which was 63.3 percent at the date of WTO accession, and then decreased to 3 percent.[59] In

56 Jenkins, 2012, p. 27.
57 Callegari, Massaroli Melo and Carvalho, 2018, pp. 1333-1334.
58 Own edition based on *WITS World Bank Database* (2000-2016), 2019.
59 Abreu, 2006.

terms of iron ore, China's share of the Brazilian total iron ore export was 53 percent in 2016.[60] China also accounted for 42 percent of the Brazilian total crude petroleum export. Thus, China is the main partner for Brazil.[61] Then why is the Brazilian export to China concentrated on few commodities?

Table 2
Brazilian Exports as Share of Total Exports to China[62]

Top exporting products	2000	2010	2016
Soybeans	29.0	23.0	39.0
Iron ore	24.0	43.0	20.0
Crude petroleum	3.1	13.0	11.0
Wood pulp	4.9	3.0	5.0

Brazil is a resource-abundant country that has a comparative advantage to further specialisation. However, the number of exporting products to the world market is more than 4000 in which Brazil has a comparative advantage. Jenkins[63] cited the research of Machado and Ferraz,[64] which studied the Brazilian exporting products and determined 58 products, trading with which Brazil had a comparative advantage with the rest of the world, but they were not exported to China in 2001 and 2002. Furthermore, there were other products that Brazil did not export to China due to import quotas and sanitary barriers: for example meat, fruits, vegetables and nuts. This Chinese import-substituting policy protects its domestic producers and puts barriers on the Brazilian export.[65] Brazil has over 600 products that are likely to be exported to China, however, the Brazilian exporters face tariff and non-tariff barriers.[66]

Another reason for the Brazilian export concentration to China is that China imports from Brazil what it needs. China's staggering demand for commodities has been increasing, and China's demand equals or exceeds that of the rest of the world in some commodity categories. China's demand for cement and nickel account for 59 and 56 percent, respectively, and the half of coal, copper, iron ore and aluminum go to China.[67] China is the top importer of iron ore, absorbing around $57 billion worth of iron ore annually that counts for the two-third of total

60 *OEC*, 2016.
61 *Ibid.*
62 Own edition based on *OEC Database* (2000-2016), 2019.
63 Jenkins, 2012, p. 27.
64 Machado and Ferraz, 2006.
65 Jenkins, 2015.
66 Jenkins, 2012.
67 Jenkins, 2018.

global iron ore imports.[68] Furthermore, China is the largest importer of crude oil, representing 17 percent of the global demand. In terms of soybeans market, China is the fastest emerging importer.

Brazilian Imports from China

In terms of Brazilian import from China, it is much more diversified compared to its export structure. The primary commodities account for less than 5 percent and the main import is categorised as manufactures. Importing products can be divided by the technological levels: low, medium and high technology products. As a result of this estimation, high technology products increased from 25 percent in 1996 to 40 percent in 2009. And the Chinese production has improved the technological ladder and boosts its comparative advantage.[69] In terms of end use, the Brazilian imports of capital goods from China account for almost the half of the total imports from China, followed by the intermediate and the consumer goods in 2016 (Table 3). The least share goes to raw materials import that sharply decreased from 54 percent in 1990 to 1.7 percent in 2016. This could happen in relation to the Chinese improved technological level and the Chinese comparative advantage in manufactures. However, it is a negative sign for Brazil that it has displaced its domestic manufacturing producers of industrial goods.[70]

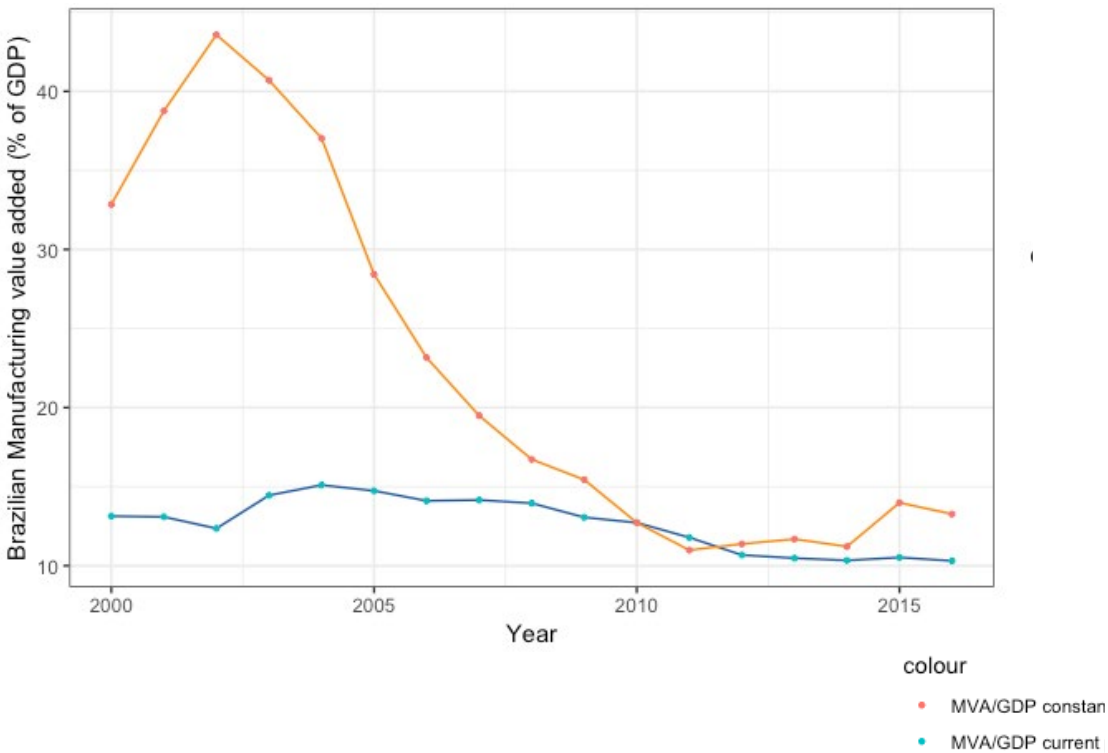
Table 3
Brazilian Imports from China[71]

	Brazilian import from China			
	1990	2000	2010	2016
Raw materials	54.77	3.55	1.32	1.77
Intermediate goods	28.68	28.24	24.09	27.68
Capital goods	9.84	42.25	52.53	49.51
Consumer goods	6.71	25.96	22.05	21.04

68 *Commodity,* 2016.
69 Jenkins, 2012.
70 Jenkins, 2012, p. 31.
71 Own edition based on *WITS World Bank Database* (2000-2016), 2019.

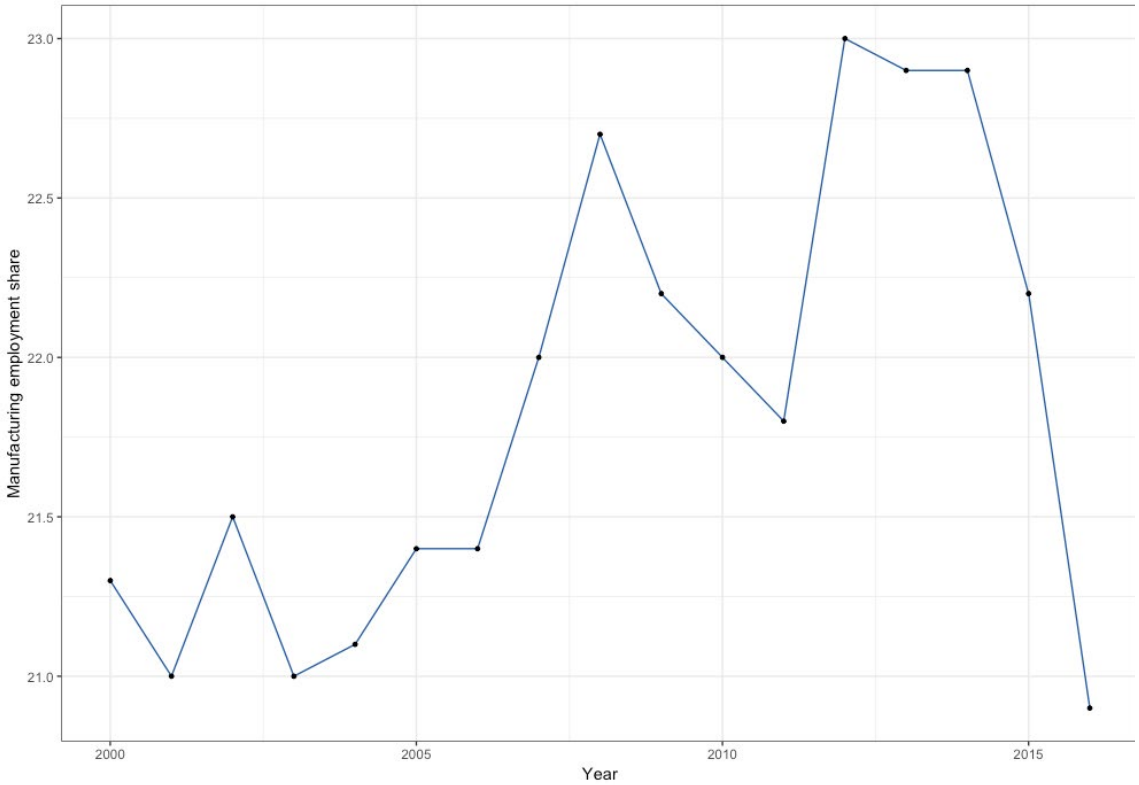
The share of MVA in GDP constant price of 2010 has been decreasing sharply since 2002 (Figure 6). MVA in constant price of 2010 rather than in current price means that it removes the price changes and shows the volume change in MVA. Therefore, the decreasing trend line of MVA/GDP in constant price indicates that the Brazilian manufacturing sector declined during the period of 2000-2016. In terms of share of manufacturing employment in aggregate employment, it had a stagnant level of around 21-23 percent between 2000 and 2016, however, it has experienced a decreasing trend since 2012 (Figure 7). Those are the signs of the idea of deindustrialisation in Brazil as deindustrialisation was stated in terms of fall in both, the share of manufacturing in total employment and the share of manufacturing in GDP.[72]

Figure 6
Brazilian Manufacturing Value-Added
(% of GDP)[73]



72 Tregenna, 2008.
73 Own edition based on *World Bank Database* (2000-2016), 2019.

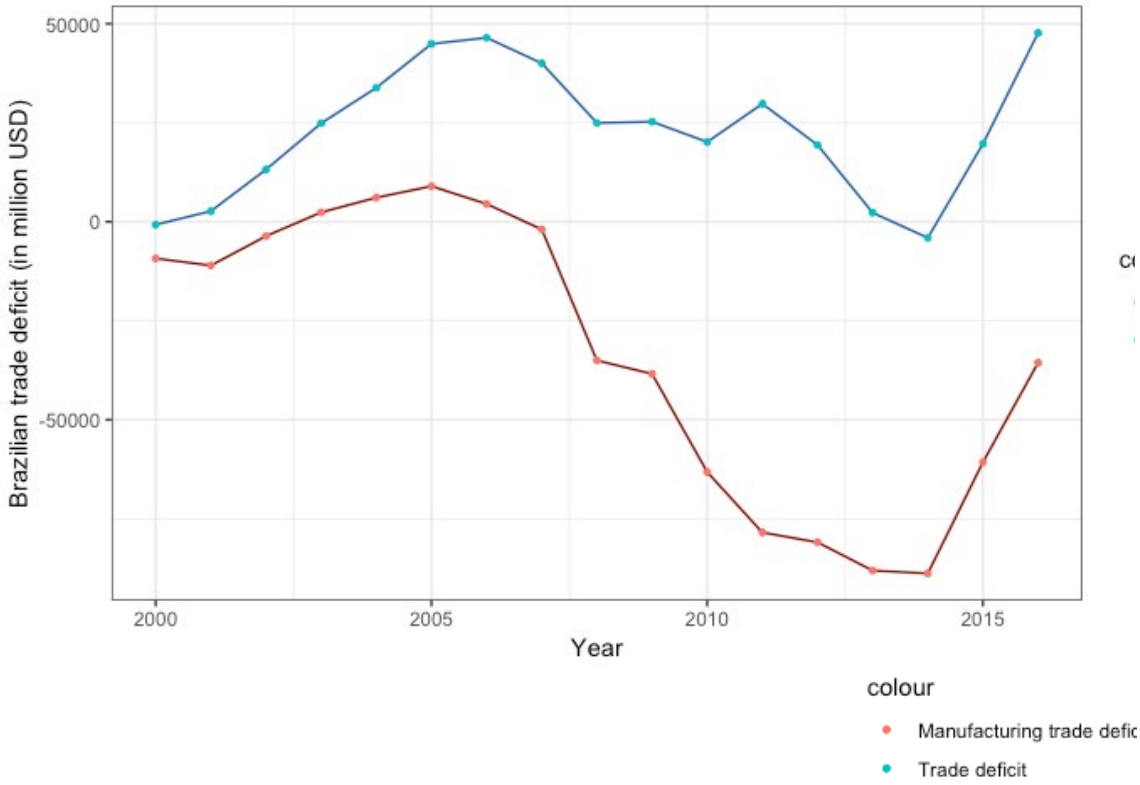
Figure 7
Brazilian Manufacturing Employment
Share in Total Employment[74]



In terms of the Brazilian trade deficit, the main contributor to the declining trend is the trade balance of manufacturing (Figure 8). The Brazilian manufacturing trade deficit has increased sharply since 2005, meaning that the country imports more than it exports. In 2005, Brazil had its peak of trade surplus in manufacturing of US$8 billion, which was around 1 percent of GDP. However, the manufacturing trade turned into a deficit from 2007, and reached US$88 billion deficit in 2014, which was equivalent to 3.6 percent of GDP. Thus, this shows an evidence for that the trade balance in manufacturing has contributed to the decreasing share of manufacturing in GDP. However, trade deficit does not tell whether it is caused by Chinese competition. China could have contributed to the Brazilian deindustrialisation in both direct and indirect ways.

74 Own edition based on *ILO Database* (2000-2016), 2019.

Figure 8
Brazilian Trade Deficits, 2000-2016
(in million USD)[75]



Indirect Impact

China's Effect on Commodities

The world commodity prices have been influenced by the Chinese demand. One of the studies by Jenkins investigated the main 15 commodities for 17 Latin American countries that benefit in export revenues from China's effect on world prices. It concluded that Latin American exports to China partly resulted in the increase of commodity prices by Chinese demand, and the majority of countries have gained on that. The main beneficiaries were the commodity exporters.[76]

China accounts for a significant share in the global consumption and world imports in terms of commodities: iron ore, copper, soybeans, aluminum, oil and coal (Table 5). This increasing demand stimulates the price of commodities in world market, and made a substantial contribution to the commodity boom. Metal prices increased four-fold and oil prices rose significantly due to the

75 Own edition based on *WITS World Bank Database* (2000-2016), 2019.
76 Jenkins, 2011.

Chinese high demand during the commodity boom period.[77] Therefore, the Brazilian export to China shifted drastically from the manufacturing to the primary commodities (unmanufactured products) because of the increasing Chinese demand for primary products. Then it led to the primarisation of Brazil's export and boosted the prices of key commodities in that export structure.

The Brazilian export increase to China was affected by the commodity prices. Taking the three most important exporting commodities to China, prices have increased considerably since 2004. After China shifted to "New normal" period from 2011, the world commodity prices have been in a decline. In terms of the most exported Brazilian commodities to China, prices have decreased significantly since 2013, and have reached at almost the same level as before the commodity boom period in 2016 (Table 6). Price changes between 2015 and 2016 brought US$637 million increase in soybeans export, US$620 million increase in iron ore export, and US$1.7 billion decrease in crude petroleum export.

Table 5
China's Share in Commodity Market (%)[78]

	Share of global consumption		Share of world imports		Share of imports in China's consumption	
	2000	2015	2000	2015	2000	2015
Iron ore	19.6	53.7	14.9	67.9	39.9	88.5
Copper	12.4	50.4	14.4	46.3	64.6	66.4
Soybeans	17.1	29.3	42.1	62	47	86.8
Aluminum	13.4	55.4	1.5	59.6	1.3	46.4
Oil	6.1	12.6	4.3	13.4	40.3	68.5
Coal	38.5	60	1.4	17.9	0.6	5.7

77 Jenkins, 2018.
78 Jenkins, 2018.

Table 6
Commodity Prices, 2010-2016[79]

	Soybeans	Crude petroleum	Iron ore
	US$/ton	US$/barrel	US$/ton
2000	211.83	28.23	28.79
2001	195.83	24.35	30.03
2002	212.67	24.93	29.31
2003	264.00	28.90	31.95
2004	306.50	37.73	37.90
2005	274.69	53.39	65.00
2006	268.65	64.29	69.33
2007	384.05	71.12	122.99
2008	522.83	96.99	155.99
2009	436.92	58.96	79.98
2010	449.80	79.04	145.86
2011	540.67	104.01	167.75
2012	591.42	105.01	128.50
2013	538.42	104.08	135.36
2014	491.77	96.24	96.95
2015	392.12	50.75	55.85
2016	405.45	42.81	58.42

Table 7 shows China's share in Brazilian commodity exports. If the 2015 market shares had been constant in 2016, around US$1.9 billion of Brazilian exports would not have been exported to China. This amount accounts for more than 30 percent of the export change of Brazil during 2015-2016.

79 Own edition based on Indexmundi Database (2000-2016).

Table 7
China's Share of Brazilian Commodity Exports[80]

	Soybeans	Crude petroleum	Iron ore
2010	63	23	44
2011	66	21	46
2012	68	23	46
2013	74	31	48
2014	71	21	46
2015	74	35	44
2016	74	42	53

Then how much did Brazil benefit from the commodity boom prices?

Brazil benefitted from the commodity boom prices until 2011, and its terms of trade increased until 2011.[81] In this growth, China played a significant role in terms of the increasing demand for primary commodities, boosting commodity prices and motivating countries to export more primary commodities since their income increases significantly. Consequently, China strengthened its comparative advantage of producing manufacturing goods, and expanded its market share.

Gallegari, Massaroli Melo and Carvalho emphasised that China gained ground in the market for industrial imports including LACs, therefore, Brazil lost its market share of manufacturing in LACs.[82] Then China's effect on the commodity price boom played a crucial indirect role not only in reducing manufacturing exports from Brazil but also in increasing the primary commodities' export. Moreover, China expanded its market share in third markets to export its manufacturing goods and Brazil heavily lost its share to China. Jenkins studied the Brazilian loss market share to China in the third market.[83] The result shows that Brazil had lost more than 10 percent of manufacturing exports to the U.S., Chile, Colombia and Venezuela, and 5 to 10 percent in Mercosur, Europe and Mexico. Therefore, the Brazilian manufacturing sector has been negatively affected by Chinese competition in the third market.

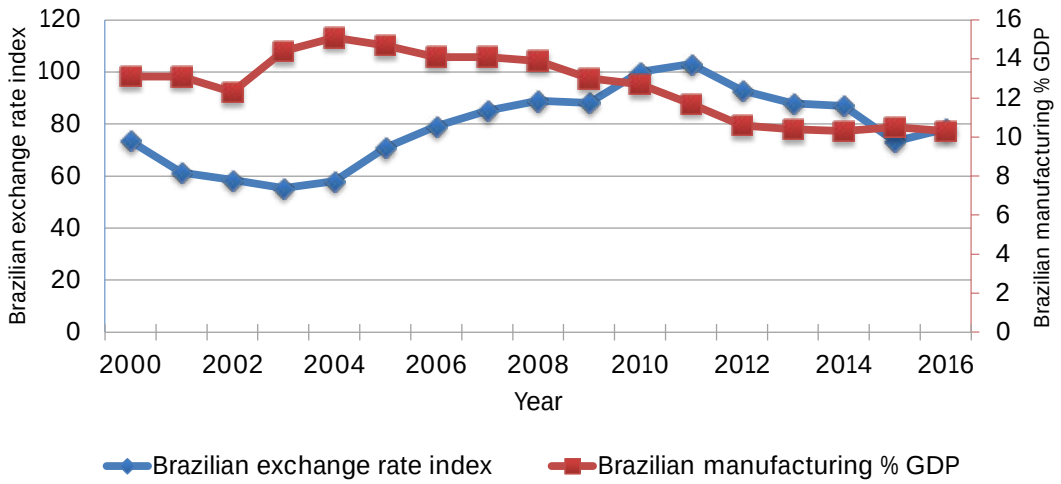
80 Own edition based on *OEC Database* (2010-2016), 2019.
81 Callegari, Massaroli Melo and Carvalho, 2018, p. 1330
82 *Ibid.*
83 Jenkins, 2015.

Brazil's Real Exchange Rate Appreciation

Jenkins studied the Brazilian exchange rate appreciation and the "Dutch disease effects", and introduced a reverse relationship between the real exchange rate and the share of manufacturing in GDP.[84] He concluded that the commodity exports' boom and the significant increase of inward FDI had influenced the real exchange rate to be appreciated. In these two main factors behind the Brazilian real appreciation, China played the major role directly and indirectly by boosting the world commodity prices, motivating the country to export more primary goods and leading to the primarisation.

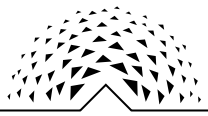
The appreciation of real exchange rate plays an important role in the deindustrialisation by decreasing the cost of importing manufacturing products and by making the domestic manufacturers difficult to compete in export markets.[85] In Brazil, the increase in the prices of primary commodities was influenced to appreciate the real exchange rate. Since 2003, Brazil's real exchange rate was appreciated until 2011 (Figure 9).

Figure 9
Brazil Index of Real Exchange Rate (2010=100)
and Share of Manufacturing in GDP[86]



However, at the same time, the share of manufacturing was reduced. From 2012, the real exchange rate began to depreciate, and the share of manufacturing started to be stabilised. It means that the real exchange rate appreciation plays the one possible indirect role in reducing the manufacturing that may lead to deindustrialisation in Brazil. Thus, China's impact on the increasing price of commodities during the commodity boom period influenced Brazil to export more commodities. This export boom

84 *Ibid.*, p. 57.
85 *Ibid.*
86 Own estimation based on *World Bank Database* (2000-2016), 2019.



played an important role in the appreciation of the real exchange rate, meaning that it can be the indirect effect of China on the deindustrialisation in Brazil through the appreciation of the real exchange rate. However, the overvaluation took place between 2004 and 2011, which overlaps the period of commodity boom and China's FDI surge in Brazil. Then the real exchange rate appreciation is not the consequence of the booming prices of commodity exports or the significantly increasing FDI inflows. Those occurrences happened at the same time. Thus, it is hard to quantify China's indirect effect on the Brazilian real exchange rate appreciation, and China's impact on the Brazilian manufacturing sector through the real exchange rate. Instead, it will be more reliable if we investigate the impact of the Chinese exchange rate devaluation on the Brazilian manufacturing sector.

Brazil's Role for China

From China's point of view, first of all, Brazil is the source of raw materials. China is in the need of providing its increasing industries with raw materials, so that its share of importing raw materials from Brazil has been increasing considerably over the past three decades. Brazil's exports of raw materials to China have increased four times, accounting for more than 80 percent of the Brazilian total exports to China. Secondly, China wants the access of export in Latin America in order to diversify its export destinations. China exports mainly to the U.S., Europe and other Asian countries, then it needs other continents to export more and to reduce its dependency on the U.S. or the European market. Therefore, China has an interest in increasing its trade relation with Brazil, which is the largest Latin American country, however, China's export share to Brazil is only around 1 percent of its total export.

In terms of FDI, China has been increasingly investing in Brazil in order to increase its global leadership role, to maintain its international image of political and economic stability, to reduce its dependency on the U.S., and to satisfy its importing commodities' need from Brazil. During the last several years, Chinese investment focus on primary commodities' sector has slightly shifted and started to diversify into other sectors. But mergers and acquisitions dominate the mode of entry meaning that China acquires more and more assets in Brazil that are already in operation. It allows China to control assets in the domestic market and to expand its power in Brazil.

China's Role for Brazil

For Brazil, China is becoming a much more important trading partner than the U.S. and Europe. Between 2000 and 2016, the percentage of Brazil's export to the U.S. decreased from 24 percent to 12 percent, and to Europe declined from 29 percent to 20 percent, whereas its export to China increased from 3 percent to 19 percent. If China continues to grow, Brazil has a great opportunity to provide

agricultural products and raw materials to China in order to supply its use of natural resources.[87] The Brazilian export to China increased more than thirty-one-fold between 2000 and 2016, yet it was concentrated on only few commodities: soybeans (39 percent), iron ore (20 percent), and crude oil (11 percent) in 2016. Furthermore, China is not only the top export destination, but also the largest origin of imports for Brazil, accounting for 17 percent of its total imports in 2016. Brazil's import from China increased eighteen-fold between 2000 and 2016. The main importing products from China are relatively diversified compared to the exports to China: telephones (6.4 percent), broadcasting accessories (3.1 percent), integrated circuit (2.5 percent), office machine parts (2.5 percent) and other equipment.

Econometric Analysis – Data and Variables

In this paper, the Vector Error Correction (VEC) model is used to evaluate the relationship between the Brazilian manufacturing sector and its trade with China, and China's growth. The vector error correction mechanism is a means of reconciling the short run behavior of an economic variable with its long-term behavior. In the analysis, monthly data are not available for all selected variables then the time period is extended from 1990 to 2016 for annual data.

The dependent variable is the Brazilian *manufacturing value-added as a percent of GDP* (BRMVA), in which manufacturing value-added (MVA) is the net output of the manufacturing sector of a country, since the purpose of this analysis is to determine how the Brazilian manufacturing sector has been influenced by China's growth.

The independent variables and hypotheses are the followings: (1) *Brazilian manufacturing import from China* (MIMP), which has a negative or competitive effect on the Brazilian manufacturing sector. (2) *Brazilian manufacturing export to China* (MEXP), in which the hypothesis can be stated as "the more Brazil exports manufacturing products to China, the more the Brazilian manufacturing industry grows". (3) *Chinese Renminbi exchange rate against USD* (CNY), which can influence indirectly the Brazilian MVA decline. Chinese exchange rate depreciation supports its export-oriented sectors, especially for Chinese manufacturers who can export their product with cheaper prices. Then it decreases the Brazilian manufacturers' competitiveness and leads to the deindustrialisation in Brazil. (4) *Chinese GDP growth* (GDP), which indicates China's expansion in terms of demand, consumption, production, imports and exports. Thus, one possible hypothesis is that "the Chinese GDP growth positively influences the Brazilian MVA".

87 Walley and Medianu, 2012, p. 728.

Vector Error Correction (VEC) Model

Step#1: Test for stationary.

Variables of BRMVA, GDP, CNY, MIMP, MEXP are stationary at 1st difference (Appendix 2). Then the unit root test for residuals of those variables are stationary at level, having p-value of 0.001 (Appendix 3). Then it can be concluded that variables are co-integrated.

Step#2: Perform Johansen cointegration test.

Maximum Eigen value cointegration test indicates that there is one cointegrating equation at the 5 percent level (Appendix 4).

Step#3: With cointegration, specify VEC model.

From the VEC estimation result, the cointegrating equation and long-run model is the following:

ECT_{t-1}=[1.000$BRMVA_{t-1}$-0.06GDP_{t-1}+0.017$MEXP_{t-1}$+0.04$MIMP_{t-1}$+0.283CNY_{t-1}-3.51]

Standard errors in ():	(0.006)	(0.024)	(0.016)	(0.071)
t-statistics in []:	[-9.53]	[0.709]	[2.813]	[3.985]

BRMVA as the target variable:

$\Delta BRMVA_t$=-0.173ECT_{t-1}+0.102$\Delta BRMVA_{t-1}$+0.012ΔGDP_{t-1}+0.032$MEXP_{t-1}$-0.043$MIMP_{t-1}$-0.771CNY_{t-1}-0.012

R^2=0.65

Adjusted R^2=0.54

Where: ECT_{t-1} is the residual of the cointegrating regression, Δ is the change in variables. In this specification, the error correction term ECT_{t-1} plays the critical role. It measures the speed of adjustment to the cointegrating relationship, if the actual relationship deviates from the long-term relationship due to disturbance and shocks.

From the result, the negative error correction coefficient (-0.173) indicates that the previous year's deviation from long-run equilibrium is corrected in the current period as an adjustment speed of 17.3 percent. The growth in BRMVA is significantly correlated to the growth in the last periods' BRMVA, and significantly negatively related to the last year change in CNY. However, the change in BRMVA in the current period is not significantly correlated with the change in the previous year's MEXP and MIMP.

Percentage change in GDP is associated with 0.012 percent increase in BRMVA on average ceteris paribus in the short run. A percentage change in MEXP is associated with 0.032% increase in BRMVA on average ceteris paribus in the short

run. The percentage change in MIMP is associated with 0.043 percent decrease in BRMVA on average ceteris paribus in the short run. The percentage change in CNY is associated with 0.771 percent decrease in BRMVA on average ceteris paribus in the short run.

VEC model equation:
D(BRMVA) = C(1)*(BRMVA(-1) + 0.283262995493*CNY(-1) - 0.0600137062098*GDP (-1) + 0.0175873928786*MEXP(-1) + 0.0460331313864*MIMP(-1) - 3.51181616913) + C(2)*D(BRMVA(-1)) + C(3)*D(CNY(-1)) + C(4)*D(GDP(-1)) + C(5)*D(MEXP(-1)) + C(6)*D(MIMP(-1)) + C(7)

Where: C(1) is the coefficient of the cointegration model. It is a speed of adjustment towards equilibrium. If C(1) is negative and significant, we can say that there is a long-run causality running from independent variables to the BRMVA. Coefficient of C(1) is negative, but p-value is 0.45, meaning that there is no long-run causality from independent variables of GDP, CNY, MEXP, and MIMP to the dependent variable of BRMVA. Then what about short run causal effects?

As shown in Appendix 5, only C(3) is significant at 5 percent level, having p-value of 0.002. It means CNY has short run causal effects on BRMVA at 5 percent level.

Step#4: Perform diagnostic tests.

Diagnostic tests display that our model has no serial correlation (Appendix 6), and there is no heteroskedasticity (Appendix 7). Correlation matrix of variables indicates that there is no multicollinearity (Appendix 8).

Conclusion

According to the WITS World Bank data, China's share in Brazilian exports grew significantly from around 2 percent in 2000 to almost 20 percent in 2016.[88] The Brazilian export to China boosted 32-fold and imports from China increased more than 18-fold between 2000 and 2016. This paper aimed to study this growing trade relation between Brazil and China, and to analyse China's impact on the Brazilian manufacturing sector. The Brazilian share of manufacturing value-added (MVA) in its GDP as constant price has been decreasing sharply since 2002. Consequently, the manufacturing employment share in total employment has a falling trend since 2012. According to Tregenna, deindustrialisation is stated in terms of fall in both, the share of manufacturing in total employment and the share of manufacturing

88 *WITS World Bank*, 2000-2016.

in GDP.[89] Therefore, Brazil has a sign of deindustrialisation, and in the long-term, the Brazilian manufacturing sector is threatened by the competing Chinese manufacturers.

Then this paper tried to distinguish the direct and indirect impacts of China on the Brazilian manufacturing industry by using a matrix that was developed by Kaplinsky and Messner in 2008 and Jenkins in 2012. The Brazilian industrial trend, export and import structure, China's effect on world commodity prices and the Brazilian real exchange rate were analysed in detail and their results showed that the Brazilian manufacturing sector had suffered due to the Brazil-China trade relation. In terms of direct effect, the Brazilian export, import and industrial trend were studied. The Brazilian exporting structure to China has shifted dramatically from the manufacturing products to the primary commodities, while the import from China mainly consists of manufacturing goods. In terms of the technological level of the Brazilian exporting products, the higher technological products account for only around 2 percent in total exports to China, so that it indicates a low innovation and a weak technological performance which have been the main problem faced by Brazil to lose its share in the international market. On the other hand, China's high technological development and cheap labor costs lead the country to export a massive amount of manufacturing products, and Brazil cannot compete against Chinese manufacturers. Furthermore, it pushed Brazil to be dependent on few numbers of primary commodities' export to China, which are soybeans, iron ore, crude petroleum and wood pulp.

The indirect effect of China on the Brazilian manufacturing sector could be much more important than the direct effect. China's effect on world commodity prices is significant due to its highly increasing demand and consumption. It was found that Brazil had benefitted from the commodity boom period until 2011 because of China's indirect effect. However, the only winners were the exporters of primary commodities that led to the primarisation of Brazil's export. On the other hand, China expanded its market share in third markets of exporting manufacturing products and Brazil heavily lost a market share to China. Furthermore, the Brazilian real exchange rate appreciated due to the commodity exports' boom and the significant increase of FDI inflows between 2003 and 2011. It can be concluded that the real exchange rate appreciation reduces the manufacturing that may lead to deindustrialisation in Brazil, however, the appreciation happened at the same time, not the consequences after the commodity boom and FDI surge. Thus, it is difficult to conclude whether China affected indirectly the Brazilian real appreciation.

The econometric analysis part used the VEC model, the most significant result indicated that China's exchange rate devaluation influenced considerably the Brazilian manufacturing sector's decline. The percentage change in CNY was associated with 0.771 percent decrease in BRMVA on average ceteris paribus in the short run. Chinese undervalued exchange rate policy supported its domestic tradable sectors, which were relatively big in terms of size compared to the

89 Tregenna, 2018.

non-tradable sectors. So Chinese undervalued exchange rate policy boosted its domestic manufacturers to export more with competitive prices that Brazilian manufacturers could not compete against and had a negative impact on the Brazilian manufacturing sector.

In overall, the Brazil-China trade relation since 2000 has led to the primarisation of Brazilian exports and has shown the signs of deindustrialisation that have negative consequences in the long-term development.

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Appendices

Appendix 1.
China's Investment in Brazil[90]

Project type	Investor	Investment amount	Size Share	Transaction party
Finance	China Communications Bank	US$ 170	80%	Banco BBM SA
Finance	China Construction Bank	US$ 720	72%	Banko Industrial and Comercial
Infrastructure	China Communications Construction Company	R$ 350	80%	Concremat Engenharia
Utilities	China Energy Engineering	US$ 190	100%	Sistema Produtor
Transport	China Merchants	US$ 920	90%	TPC
Automobile	Chinese TLC Multimedia	US$ 60		SEMP
Energy	CNOOC and CNPC	US$ 1400	10%, 10%	Petrobras, Shell
Transport	HNA	US$ 460	24%	Azul Linhas Aereas Brasileiras
Transport	HNA	US$ 320	60%	Odebrecht
Agriculture	Shanghai Pengxin Group	US$ 200	57%	Fiagril Ltda
Transport	JAC Motors	US$ 100	20%	SHC
Technology	Lenovo	US$ 150	100%	Digibras and Dual
Energy	Sinochem	US$ 3070	40%	Statoil
Energy	Sinopec	US$ 7100	40%	Repsol
Energy	Sinopec	US$ 4800	30%	Galp Energia
Energy	State Grid	US$ 1720	100%	Plena Transmissoras
Energy	State Grid	R$ 14200	54.64%	CPFL Energia in Brazil
Metals	Taiyuan Iron, CITIC, Baosteel	US$ 1950	15%	CBMM
Energy	Three Gorges	US$ 130	50%	Cachoeira-caldeirao
Energy	Three Gorges	US$ 250	50%	Jari
Energy	Three Gorges	US$ 390	33%	Terra Novo
Energy	Three Gorges	US$ 140	49%	EDP
Energy	Three Gorges	US$ 1200		Duke Energy of Brazil
Metals	Wuhan Iron and Steel	US$ 400	22%	MMX Mineracao

90 The American Enterprise Institute and The Heritage Foundation.

Appendix 2.
Unit Root Test for Variables

Indicators	Result of Stationary Test									
	Level (test critical values)				Y/N	1st difference (test critical values)				Y/N
	ADF	1%	5%	10%		ADF	1%	5%	10%	
BRMVA	-2.22	-4.35	-3.59	-3.23	N	-4.85	-3.72	-2.98	-2.63	Y*
CNY	-2.8	-4.37	-3.6	-3.23	N	-4.67	-3.72	-2.98	-2.63	Y*
GDP	-3.59	-4.35	-3.59	-3.23	N	-4.22	-3.72	-2.98	-2.63	Y*
MIMP	-1.11	-4.35	-3.59	-3.23	N	-4.28	-3.72	-2.98	-2.63	Y*
MEXP	-1.94	-4.39	-3.61	-3.24	N	-6.2	-3.72	-2.98	-2.63	Y*

Y means data is stationary;
N means data is non-stationary;
* shows data is stationary at 1% of significance;
** shows data is stationary at 5% of significance.

Appendix 3.
Unit Root Test for Residuals

Null Hypothesis: RESIDUALS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.512285	0.0015
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESIDUALS)
Method: Least Squares
Date: 03/30/19 Time: 15:18
Sample (adjusted): 1991 2016
Included observations: 26 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUALS(-1)	-0.807761	0.179014	-4.512285	0.0001
C	-0.010054	0.018104	-0.555342	0.5838

R-squared	0.458981	Mean dependent var	-0.013059
Adjusted R-squared	0.436438	S.D. dependent var	0.122884
S.E. of regression	0.092250	Akaike info criterion	-1.854822
Sum squared resid	0.204242	Schwarz criterion	-1.758045
Log likelihood	26.11269	Hannan-Quinn criter.	-1.826954
F-statistic	20.36072	Durbin-Watson stat	1.815963
Prob(F-statistic)	0.000144		

Appendix 4.
Cointegration Test

Date: 03/18/19 Time: 12:35
Sample (adjusted): 1992 2016
Included observations: 25 after adjustments
Trend assumption: No deterministic trend
Series: BRMVA CNY GDP MEXP MIMP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.728297	79.18884	60.06141	0.0005
At most 1 *	0.613719	46.61265	40.17493	0.0099
At most 2	0.455960	22.83290	24.27596	0.0752
At most 3	0.237932	7.614594	12.32090	0.2681
At most 4	0.032330	0.821595	4.129906	0.4206

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.728297	32.57619	30.43961	0.0267
At most 1	0.613719	23.77975	24.15921	0.0562
At most 2	0.455960	15.21830	17.79730	0.1172
At most 3	0.237932	6.792999	11.22480	0.2680
At most 4	0.032330	0.821595	4.129906	0.4206

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 5.
Short Run Causal Effects

Coefficients		P-value
C(3)	D(CNY(-1))	0.002
C(4)	D(GDP(-1))	0.194
C(5)	D(MEXP(-1))	0.367
C(6)	D(MIMP(-1))	0.296

Appendix 6.
Serial Correlation LM Test

VEC Residual Serial Correlation LM Tests
Date: 03/30/19 Time: 15:54
Sample: 1990 2016
Included observations: 25

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	23.45690	25	0.5509	0.918433	(25, 34.9)	0.5818
2	28.74319	25	0.2748	1.197665	(25, 34.9)	0.3066

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	23.45690	25	0.5509	0.918433	(25, 34.9)	0.5818
2	69.63968	50	0.0345	1.557485	(50, 21.6)	0.1310

*Edgeworth expansion corrected likelihood ratio statistic.

Appendix 7.
Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests (Levels and Squares)
Date: 03/30/19 Time: 15:54
Sample: 1990 2016
Included observations: 25

Joint test:

Chi-sq	df	Prob.
188.0240	180	0.3257

Appendix 8.
Correlation Matrix

	D(BRMVA)	D(CNY)	D(GDP)	D(MEXP)	D(MIMP)
D(BRMVA)	1	0.238849056	0.146786269	0.082498536	-0.214068561
D(CNY)	0.238849056	1	0.155396716	-0.432373018	-0.123033759
D(GDP)	0.146786269	0.155396716	1	-0.026670197	-0.392780384
D(MEXP)	0.082498536	-0.432373018	-0.026670197	1	0.308808729
D(MIMP)	-0.214068561	-0.123033759	-0.392780384	0.308808729	1