Universidade Federal Fluminense

TEXTOS PARA DISCUSSÃO

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Trade Patterns in a Globalised World: Brazil's Recent Trajectory Towards Regressive Specialisation

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TD 339
Junho/2018

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ABSTRACT

Globalisation can be defined as the extent and intensity with which a country's production, trade and capital flows are integrated in the world economy. Our focus is on the globalisation through international trade flows. After analyzing the main theoretical predictions about the effects of global trade integration on trade patterns between countries of different levels of income and technology, this paper investigates the case of Brazil, focusing on its trade integration over the last 26 years (1990-2016). Particularly, we are interested in investigating whether or not (and if so, to what extent) Brazil's recent trajectory has been directed to a regressive pattern of specialisation. By regressive specialisation we refer to that in which both production and export structures are strongly oriented to goods of low technological sophistication and low income-elasticity of demand. The recent theoretical literature on technological gaps and long-term growth suggests that when a country enters into a quick and sustained regressive pattern of specialisation, its capacity of showing growth rates aligned with its balance-of-payment equilibrium is reduced and, therefore, a falling behind trajectory is observed. Our main empirical findings are (i) the technological gap significantly widened for all groups of manufactured goods classified by factor content and technological sophistication; (ii) the income elasticity of demand for Brazilian exports is greater than for Brazilian imports, suggesting a regressive specialisation concentrated in low-tech goods and implying that growth has been constrained by long-term balance-of-payments equilibrium (Thirlwall's law); and (iii) a very marked trend of high concentration of Brazilian exports in primary goods, but a more diversified basket of imports composed of high technologically sophisticated manufactured goods, reinforcing the regressive specialization of Brazil's trade pattern in the last decades.

KEYWORDS: patterns of specialisation; regressive specialization; diversification; Brazil.
JEL: F10; F11; F12; F14.

Introduction[*]

Globalisation can be defined as the extent and intensity with which a country is integrated in the world economy. Although such integration can and does reach production, trade and capital flows, our focus is on the globalisation through international trade flows. Although other earlierwaves of economic internationalisation have happened—from the Industrial Revolution till the beginning of World War I—, the speed and intensity with which the present wave of trade globalisationhas spread over the entire world economy since the early 1980s has no precedent in the modern occidental economic history. In fact, from the 1980s onwards, the rise and diffusion of the microelectronic revolution as well as the significant reduction of trade barriers also put pressureon most developing countries to accelerate trade integration into the world economy.

In the case of Brazil, for instance, between 1990 and 1994, after several decades of protectionist policies adopted under the import substitution development strategy, the Brazilian government decide to adopt a unilateral and ambitious trade liberalisation programme, which eliminated most non-trade barriers and reduced average nominal tariffs for all goods from 30.5% to 11.2%.[1] Since several studies were released in the 1990s and 2000s with the goal of evaluating the impacts of the Brazilian trade liberalisation experience on productivity, trade pattern, employment, etc.,[2] this paper does not aim at replicating such studies. However, there is extensive literature documenting that two marked phenomena have characterised the Brazilian economy in the last 25 years: the first one is the significant and continuous reduction of the share of value-added industrial activities in the GDP;[3] and the second one is a recurrent long-term trend of overvaluation of the Brazilian currency in relation to the currencies of Brazil's main trading partners.[4] Although the second phenomenon

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[1] See Kume, Piani and Souza (2000:11).
[2] See Feijó and Carvalho (1994), Moreira and Correa (1998), Bonelli and Fonseca (1998), and Nassif (2003).
[3] See Nassif (2008), Oreiro and Feijó (2010) and Nassif, Feijó and Araújo (2015), among others.
[4] See Bresser-Pereira (2010), Nassif, Feijó and Araújo (2017) and Nassif, Bresser-Pereira and

may havecontributed to deepening the first one, both may have influenced the observed changes in the pattern of trade integration of the Brazilian economy in terms of sectoral specialisation, geographical composition of trade flows and the competitiveness of Brazilian goods.

This paper has two main goals: first, it reviews and analyzes the main theoretical predictions about the effects of global trade integration on trade patterns between countries of differentincome and technological levels; and second, it investigates the case of Brazilian trade integrationover the last 26 years (1990-2016). Particularly, we are interested in investigating whether or not (and if so, to what extent) Brazil's recent trajectory has been directed to a regressive patternof specialisation. By regressive specialisation we refer to thatin which both production and export structures are strongly oriented to activities or segments of low technological sophistication and low incomeelasticity of demand.[5] As we will further discuss, the recent theoretical literature on technological gaps and long-term growth suggests that when a country enters into a quick and sustained regressive pattern of specialisation, its capacity of showing growth rates aligned with their balance-of-payment equilibrium is reduced and, therefore, it enters a "falling behind" trajectory, the term coined by Abramovitz (1986) to contrast with a "catching up" path.

For analyzing Brazil's recent change in trade patterns, we will estimate the following indicators: (i) incomeelasticity of demand for exports and imports; (ii) the composition and dynamics of both exports and imports classified by factor content and degree of technological sophistication; (iii) the degree of export diversification and the importance of the extensive and intensive margins of trade for Brazilian exports, whose indicators permit us to measure the extent to which Brazil's export expansion resulted from the expansion of "old" (intensive margin) or"new" (extensive margin)products; iv) the degree of concentration versus diversification of the export basket; v) the index of intraindustrial trade; and vi) the geographical distribution of exports and imports. Most indicators will be calculated through descriptive statistics, using a methodology compiled by Reis and Farole (2012).

Feijó (2017).

[5]Coutinho (1997) first coined the term regressive specialisation when analysing the Brazilian economy throughout the 1990s. In our paper, rather than production, we will emphasise the trade (export and import) structures.

The paper is divided into 4 sections, including the Introduction. Section 2 presents a theoretical analysis of the determination oftrade patterns in a globalised economy, emphasising recent theories of international trade and focusing on trade flows between countries with different per capita income and technological levels. Section 3 presents a general view of the Brazilian economy during the period under study and shows empirical evidence of Brazil's recent experience, based on the above-mentioned indicators. Section 4 draws the main conclusions of the study as well as suggestingsome policy implications.

Trade patterns in a globalised world: a survey of the theoretical literature

Trade patterns in traditional trade models of comparative advantage

The investigation of the determinants of trade patterns and the advantages of a country to engage in global trade has been a long tradition in economics. In the classical political economy, technological capacity was the main source for explaining different sectoral productivity levels between countries and, therefore, the existence of global trade. Adam Smith (1776), however, was more worried about the effects of global trade on a country's economic growth,while David Ricardo (1817) and John Stuart Mill (1848) deviated completely from the theoretical analysis tothe effects of international trade on the allocative efficiency of productive resources and its capacity to increase social well-being by augmenting the trade volume between countries engaged in free trade. Indeed, in Smith's theoretical analysis, trade was driven by differences insectoral absolute costs between countries (which reflect, in turn, differences of absolute technology and productivity), whereas in Ricardo's and Mill's analysis, trade was driven by differences insectoral relative costs (which reflect, in turn, differences of comparative productivity). Since in Ricardo's and Mill's theoretical framework technology was exogenously determined and evaluated in comparative terms, they starteda long-lasting tradition in which trade patterns were basically determined by supply-side forces.

In the modern neoclassical theoretical treatment of Ricardian analysis, the determination of trade pattern by comparative advantage depends on several unrealistic assumptions, such as perfect competition in goods and labour markets, total domestic labour mobility, technologies subject to constant returns to scale and full employment. Under such conditions, by extending the analysis to many goods (a *continuum* of goods), Dornbusch, Fischer and Samuelson's (1977) seminal paper showed that comparative advantage and trade pattern are jointly determined by different relative productivities at the sectoral level and different relative wages between countries. In fact, sincedifferences in sectoral relative productivities are determined first and ranked for each country, andgiven a country's relative wage compared with another trade partner, it is possible to determine the range of goods in which each one of them has comparative advantage. As the expenditure shares are the same in both trade partners (homothetic demand), the demand side has no role in determining trade pattern. In such circumstances, international trade leads to complete interindustrial specialisation, even considering that a subset of goods cannot eventually be traded, be it because relative unit labour costs (that is, the ratio of wage rates to labour productivity) are the same in both countries, orbecausetransport costs can be high enough to work as a trade constraint.

Although the Ricardian hypothesis for determininga country's trade pattern (different sectoral relative productivities reflecting distinct relative technologies) has been supported by several empirical tests,[6] it was the Heckscher-Ohlin(H-O) version of comparative advantage that became the standard neoclassical trade model for explaining trade pattern, gains from trade and advantages of free trade policies.In fact, in an original paper written when Sweden was still a net export of agricultural goods, Eli Heckscher (1919) argued that, in a world characterised by different relative factor endowments, each country tends to specialise in the production of goods intensively using the abundant factor, importing goods that intensively use the scarce factor. In a doctoral thesis supervised by Heckscher, Bertil Ohlin (1924) transformed those original views intoan elegant mathematical framework that not only permitted

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[6] See McDougall (1951) and Eaton and Kortum (2002).

the determinationof a unique solution for the trade pattern, but also the establishment of a theoretical basis for developinga set of important theorems about global trade by neoclassical economists.

The original model proposed by Ohlin (1924)is based on the following set of assumptions: (i) the technology of each industry *i*, subject to constant returns to scale,isthe same for all countries in the world; (ii) there is no possibility of factor-reversal (that is, the technology cannot be reversed by changes in factor prices); (iii) each country ("region", in Ohlin's word) is defined by its relative factor endowment; (iv) each factor of production has perfect domestic mobility; (v) relative abundance or scarcity of each factor of production defines its relative price in autarky; and (vi) given production functions and preferences, each country has its relative goods and factor prices, output and resources allocation determined by the Walrasian general equilibrium mechanisms. The main proposition of the H-O model is that each country exports goods that intensively use the abundant factor in theirproduction, and imports those that intensively use the scarce factor.

In his book "Interregional and International Trade", Ohlin (1933) showed that, if the world economy was characterised by industries that operate under perfect competition and factor immobility, free trade—by changing relative factor prices in each country—would be the main channel explaining geographical location of productive activities and pattern of specialisation.It is worth noting that, in the H-O model, the unrealistic assumption of identical and unchanged sectoral technologies between countries is kept even when relative factor prices arechanged by free global trade. In a word, trade is the main channel throughwhich each country can surpass the scarcity of some factors of production.

The original presentation of the H-O model in a Walrasian general equilibrium framework eased the development of important theorems related to free trade. The first one, shown by Samuelson (1948; 1949), is the factor price equalisation theorem, which predicts that, under a set of restricted conditions, such as perfect competition in goods and factors markets (in a model of two sectors and two factors), homothetic demand and trade completely determined by the H-O proposition, free trade integration tends to generate a total

equalisation of goods and factor prices since both goods will be produced by both countries. The intuition of this theorem is simple: since a country can use more than one factor (say, capital and labour, and not only one factor, as in the Ricardian model), trade in goods generates a full equalisation of factor prices through full equalisation of goods prices.[7] As Feenstra (2004: 13) points out, the factor equalisation theorem suggests that "trade in goods is a perfect substitute for trade in factors".In the face of large inequality in wages between countries in the global economy, the theorem has a very unrealistic conclusion. However, it demonstrates that free global trade generates, at least, changes in relative goods and factor prices compared with those observed in autarkic conditions.

The second theorem, demonstrated by Stolper and Samuelson (1941),shows thatif comparative advantage is the main force to govern trade patterns in the global economy, free trade can predict net gains for society as a whole in each country, but its impacts on income distribution is unequal among the factors of the owners of production. The intuition of this theorem is also quite simple: it says that, if two goods are produced under constant returns to scale and perfect competitive conditions in a country, the engagement in free trade relations tends to increase the relative price of the exported good and, therefore, to also increase the relative price of the factor intensively used in its production; buttends to decrease the relative price of the importedgood as well as the relative price of the factorintensively used in its production. In a word, the Stolper-Samuelson theorem shows that free trade redistributes the national income to the owners of the abundant factor in such a way that the main losers are the owners of the scarce factor.

It is curious that most studies based on the H-O model do not worry aboutthe eventual effects of technological change ona country's trade pattern. If technical progress occurs, it is always an exogenous phenomenon. The same cannot be said about changes in a country's endowment. In this case, asthe third theorem derived from the H-O model stresses (the Rybczynski theorem), a change in factor endowment of a country will change the relative output of the economy. Rybczynski (1955) supposes two factors (say, naturalresources and labour) and two industries (one natural resource-based, and the other, labour

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[7] For an original mathematical demonstration, see Samuelson (1949), and for a rigorous recent demonstration, see Feenstra (2004:13-15).

intensive) subject to constant returns to scale and perfectly competitive. If new large sources of natural resources are discovered in a country, there will be a disproportional rise in the output of the natural resource-based sector and a contraction of the labour intensive. This result depends on the relative factor prices remainingunchanged, a requirement that is easily satisfied because the relative demand of the factors is going inopposite directions (while demand of natural resources is increased, the demand of labour is contracted proportionally).

It is important to remember that the normative implications of the H-O model and the factor price equalisation theorem were severely criticised by Latin American economists in the early1950s. The most severe attack came from Raúl Prebisch, the first executivesecretary of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). In an influential paper, Prebisch (1950) criticised the main hypothesis that supports the equalisation factor price theorem: first, while the theorempredicts that the engagement of primary products exporting countries in free global trade would favour relative prices and industrialisation by importing capital goods with falling relative prices, Prebisch (1950) argued that such a result depends onthe income elasticity of demand of both goods beingequal to one, a hypothesis not held in practice;[8] and second, as empirical evidence shows that manufactured goods (the main imported good of Latin American countries) have much higher income elasticity of demand in the long run, periphery countries specialised in primary and commodity goods have their long-term economic growth recurrently constrained by balance of payments crisis.[910]

Indeed, thesoundness of the H-O model as a general theoretical approach to explain trade patterns and gains from trade has long livedup to

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[8] In Prebisch's (1950:1, italics ours) words, "it is true that the reasoning on the economic advantages of the international division of labour is theoretically sound, but it is usually forgotten that *it is based upon an assumption which has been conclusively proved false by facts.* According to this assumption, the benefits of technical progress tend to be distributed alike over the whole community, either by the lowering of prices or the corresponding raising of incomes".

[9] As Thirlwall (2011:13) recognized, Prebisch's (1950) equation expressing his centre-periphery model was "the true forerunner of my [that is, Thirlwall's] balance of payments constrained growth model developed much later".

[10] Needless to say, Prebisch's (1950) criticism was related to the long-term trend (or secular trend) of the incomeelasticity of demand of manufactured goods *vis-à-vis* primary and commodity goods. In other words, rather than static gains from trade, Prebisch was worried aboutthe dynamic effects on economic development for countries unconditionally engaged in free global trade and specialised in primary goods.

theoretical and empirical proofs.The theoretical model was originally developed for two sectors, two factors and two countries (2x2x2 model). However, if we consider an extended H-O model including many goods, many factors and many countries, the determination of the trade pattern becomes quite complicated. Several studies have shown that the trade pattern, the factor price equalisation and the Stolper-Samuelson theorem are only rigorously determined if the number of goods, factors and countries is equal. In the more realistic case in which the number of goods is higher than the number of factors (maintaining two trade countries), the trade pattern is indeterminate (Feenstra, 2004:65).

At the empirical level, the most controversial result was the famous Leontief's (1953) test which, by calculating the capital/labour ratio for US exports and imports for 1947, showed that the share of US exports was mostly labour-intensive.Since the US was then considered a capital abundant country, the Leontief paradox revealed the theoretical inability of the H-O model to explain the country's trade pattern. Since Leontief's (1953) test was published, the H-O model has been subjected to a continuing debate between Neoclassical and Structuralist economists. Within the Neoclassical framework, the first discussions concentrated on possible explanations for Leontief test not to validate the H-O predictions, such as having ignored other factors of production (e.g., land) not capital and labour and not having considered skilled and unskilled labour. At the empirical level, since the original H-O model did not take into consideration such a hypothesis, this kind of criticism is misleading (Feenstra, 2004:37).

Since then, empirical tests on the main predictions of the H-0 model have used the procedure suggested by Vanek (1968), according to which, instead of the capital-labour ratio of exports and imports, as in Leontief's test, the test should estimate the factor content of exports as well as the factor content of imports. Through input-output matrices, he suggests computing the factor service content in each exported and imported good. For instance, an estimate of Brazil's net exports (calculated as the difference between the domestic output and domestic consumption) results in the difference between the factor content of its exports and the factor content of its imports. If the difference is positive, it means that Brazil exports (on net) the services of this input; if the difference is negative, it means that Brazil imports (on net) the services of this input. The

Heckscher-Ohlin-Vanek (H-O-V) model is appealing for permitting friendlier empirical tests on trade pattern based on the factor proportion model. However, the Vanek (1968) model requires several restricted assumptions, such as identical constant-returns-to-scale technologies for all countries in the world and total factor price equalisation. Despite this, the modern acceptance of factor proportion theory is considered within the H-O-V framework.[11]

As to Structuralist criticisms on the H-O model, the Leontief paradox gave rise to several academic studies in the 1960s aiming at investigating new hypotheses for explaining trade patterns in the manufacturing sector as well as the dynamic effects of free global trade on long-term growth. This will be discussed in the following subsections.

2.2 From the heterodox models of the 1960s to the "new trade theories" of the late 1970s and onwards

Linder's demand-push trade model and the "new trade theories" of the late 1970s and onwards

The so-called "new trade theory", a modern theoretical current of international trade captained by Paul Krugman, Elhanam Helpman, Anthony Venables, James Brander, Barbara Spencer and others, justifies the adjective "new" because most models incorporate imperfect competition, increasing returns to scale and the dichotomy of homogeneous versus differentiated goods as basic assumptions. However, such assumptions had been considered by heterodox authors in the 1960s, like Staffan Linder (1961), Michael Posner (1961) and Raymond Vernon (1966).Indeed, differently from the former group of authors, this latter group,as theydid not construct formal trade models, treated forces such as oligopolistic or monopolistic competition, product differentiation and economies of scale more as possibilities than precise hypotheses. Even so, the major innovation of some of these modelspioneered a demand basis trade theory for explaining a country's international competitiveness for exporting manufactured goods. In this subsection, we will only present the Linder (1961)

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[11] See, for instance, Helpman and Krugman (1985, ch.1) and Feenstra (2004: 37-56) for mathematical demonstrations. See Helpman (2011:38-45) for textual presentation.

model.

Linder (1961) accepts the theoretical hypothesis of factor endowment for explaining international trade of natural resources-based goods (especially agricultural goods). However, he rejected the H-O model in the explanation of international trade in manufactured goods. His model is one of the first to emphasise the central role of domestic market size in providing demand high enough for creating potential international competitiveness for a country to export manufactured goods. Likeunder free trade, the initial costs are high enough for firms of the manufacturing sector to export.As a matter of fact, Linder (1961) stresses that a "representative demand" must existin the domestic market before the global markets can be reached. In other words, as most industrial firms of the manufacturing sector have to choose technologies subject to increasing returns to scale, they will not be able to have international competitiveness for exporting such goods if the size of the domestic market is not large enough to providethemminimum efficient scales. For Linder, then by taking advantage of their proximity to their respective domestic markets, firms seek to explore economies of scale in order to reach foreign markets in the future.In Linder's (1961) theoretical model, the higher a country's per capita income, the higher will be the size of its domestic demand andthe more sophisticated will be the demand pattern.Thus, its potential for exporting manufactured goods will be higher. His main conclusion is that countries withthe highest and closest levels of per capita income have a significant share of their manufacturing trade characterised by intraindustrial trade of differentiated goods. The importance of Linder's theoretical model is that he was the first to explain the predominance of manufactured goods in the trade among countries of similar per capita income. His main contribution is that he was the first to not only indicate economies of scale and product differentiation as the main sources of intraindustrial global trade, but also to suggest that such sources are primarily realised in the domestic marketplace, before firms areable to compete in the global markets.[12]

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[12] It is unacceptable that Linder's (1961) contribution, despite being recognized by Krugman's (1979) seminal paper, has been omitted from the bibliographic references in Krugman, Obstfeld and Melitz (2012), Helpman and Krugman (1985) and Feenstra (2004), the three leading textbooks in undergraduate and graduate courses.

Yet, from the late 1970s on, a set of neoclassical models labelled by Krugman (1990) as "new trade theory" began to appear. Rather than for having incorporated imperfect competition, the adjective "new" can be justified by three main reasons:

i) First, because these models demonstrated that, in certain oligopolistic cases, as trade pattern depends on a combination of complex factors existing in each country, such as market size, number of competing firms, factor prices, barriers to entry, etc., its theoretical determination is much harder to predict; in some cases, the trade pattern is either undetermined (see Helpman and Krugman, 1985: 86-88) or presents multiple equilibria (see Helpman and Krugman, 1985:53-55);

ii) Second, because these authors mathematically demonstratedthe original Graham's (1923) conjecture according to which, in the presence of economies of scale and market power, trade globalisation can, under certain conditions, lead to an unequal distribution of gains among countries. If for example, trade reallocates productive resources from sectors subject to increasing returns to scale to sectors subject to constant returns to scale in a country, all gains from trade may be appropriated by the countries whose reallocation of resources happened in the opposite way (see Helpman and Krugman, 1985:50-55);

iii) And third, because, by using Vanek's (1968) suggestion of estimating the trade pattern based on the factor content services presented in both exports and imports, these models also seek to show how the basic H-O-V model can interact with new models incorporating economies of scale, product differentiation and monopolistic competition.

In this section, as we are interested in cases in which the trade pattern can be determined and the gains from trade are assured for all countries, the new trade theory shows that such cases are only guaranteed ifimperfect competition assumes the monopolistic competition form.[13]In the basic model

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[13] We leave the cases in which the presence of increasing returns to scale makes a country reduce its social well-being and long-term growth after engaging in free trade for the next
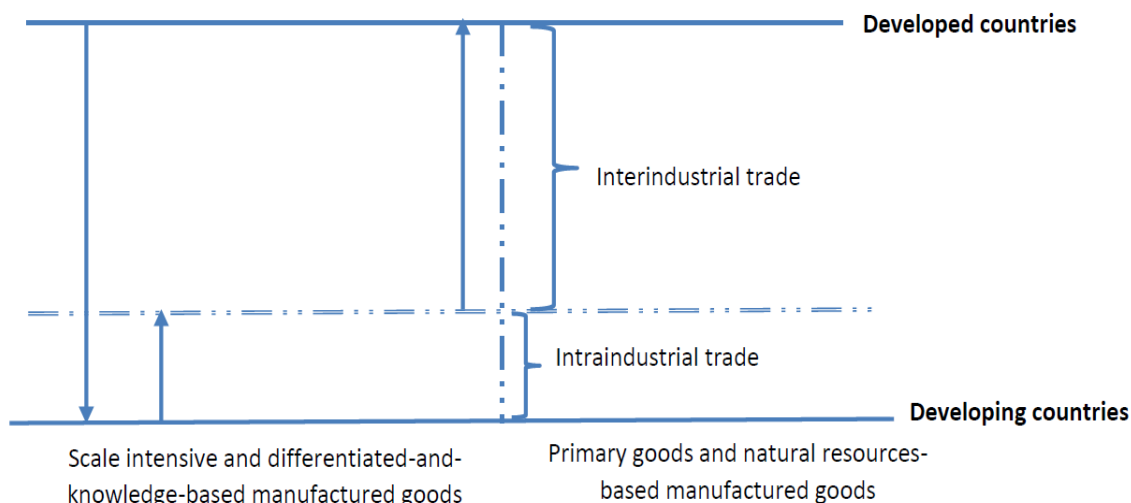
presented by Krugman (1979, 1980), an industry fromtwo countries iscomposed ofseveral firms producing a large number of differentiated goods and competing in monopolistic competition. Despite all firms using only one factor of production (labour), as technology isidentical for all firms, but subject to economies of scale, and all differentiated products enter symmetrically into demand, each firm produces only one differentiated and close substitute good. As competition is driven by product differentiation, each firm chooses its price and maximizes profits by equalising marginal revenue to marginal cost, but ignoring the prices fixed by their competitors in the market.

To demonstrate that the economies of scale are the main cause for trading, Krugman (1980) also supposes that both countries have the same factor endowments and technological level. Considering zero transport costs, if these countries decide to engage in free trade, rather than being driven by any difference between relative costs or factor endowments (as in traditional models of comparative advantage), trade pattern will be determined by economies of scale and product differentiation, in such a way that each differentiated good is produced by only one firm and in only one country.[14] Differently from comparative advantage, in which trade pattern is of the interindustrial type, trade pattern driven by economies of scale and product differentiation is of the intraindustrial type. As Krugman (1980:952) concludes, "gains from trade will occur because the world economy will produce a greater variety of goods than would either country alone, offering each individual a wider range of choice". Even though the **direction** of trade is undetermined, since all range of goods are differentiated, it does not matter who produces what, but rather that trade integration provides a greater **volume** of varied goods. In an extendedmodel, Krugman (1980) also considers the case in which one of the two countries has a larger domestic market than the other. The result is as intuitively expected: since a larger domestic market has a major potential for exploring economies of scale, the bigger country will be a net exporter of all range of goods whose technology is subject to increasing returns to scale, as had already been suggested by Linder (1961).

FIGURE 1:GLOBAL TRADE BETWEEN DEVELOPED AND DEVELOPING COUNTRIES

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section.

[14] The introduction of transport costs does not modify the general results. See Krugman (1980, section II:953-955).

Developed countries

Interindustrial trade

Intraindustrial trade

Developing countries

Scale intensive and differentiated-and-knowledge-based manufactured goods

Primary goods and natural resources-based manufactured goods

Source: Elaborated by the authors, based on Krugman (1990:77)

In another paper, Krugman (1981) integrated the traditional Heckscher-Ohlin trade model with the main features of the new trade theory, whose results are illustrated in Figure 1. With this paper, Krugman completed the trilogy that might have justified his Nobel Prize laureate in 2008.[15] Krugman (1981) proposed a model in which the global economy is composed ofseveral countries defined by either their similarityor differences in their factor endowments.[16] In practical terms, if we divide this world into two groups of countries, the first would be formed by all capital-abundant developed countries, while the second would be composed ofallnatural-resources-abundant developing countries.The global output is composed of two sectors: a capital-intensive, which produces scale intensive and differentiated-and-knowledge-based manufactured goods subject to increasing returns to scale and monopolistic competition; and a natural resources-based, which produces primary and natural-resources-based manufacturedgoods subject to constant returns to scale and perfect competition.

As Figure 1 illustrates, given the different factor endowments of the two groups of countries, a free integration of their markets implies that the resulting

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[15] The trilogy is composed of the 1979, 1980 and 1981 Krugman papers (the 1990's paper summarises the 1981's). According to the Nobel Prize Committee, Krugman was honoured with the prize in economics in 2008 "for his analysis of trade patterns and location of economic activity". See https://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2008/press.html

[16] This is a free adaptation of Krugman's (1981) seminal model, which was summarized by Krugman (1990). In this model, instead of capital and labour factors of production, the author uses only labour, differentiated by labour type 1 and labour type 2. Two countries will have identical factor endowments, if, by indexing their respective labour force as $L_1 = 2 - z$ and $L_2 = z$; and $L_1^* = z$ and $L_2^* = 2 - z$ (asterisks refer to the second country), the result for z is equal to 1.

net trade pattern will be mainly driven by the traditional H-O model and predominantly of interindustry type. In other words, while the developed countries will be net exporters of technologically sophisticated manufactured goods, which intensively use the services of the abundant factor (capital) available in this group, the developing countries will be net exporters of primary goods and industrial commodities, which intensively use the abundant factor (natural resources) available in this group. However,there may be a range of intraindustrial trade inscale intensive and differentiated-and-knowledge-based manufactured goods between both groups, but the more different their respective factor endowments, the smaller the volume of such flows, which are, as already shown, driven by economies of scale and product differentiation. Summing up, Krugman's (1981) model demonstrates why most of the global flows of technologically sophisticated manufactured goods are concentrated in rich countries whose factor endowments are similar to each other.

The "new new trade theories" of intrafirm global trade and theoretical models explaining the genesis of global value chains

More recently, a new generation of neoclassical trade models (the "new new trade theory") has predicted intrafirm global tradein which a significant share of manufactured goodsisproduced and traded by heterogeneous firms ranked among the highest level of productivity (see Helpman, 2011, ch.5; and Melitz and Trefler, 2012). Melitz (2003) developed the seminal intrafirm trade model. By departing from similar assumptions on intraindustrial trade with monopolistic competition, Melitz (2003) assumes that a firm's entry into a segment of differentiated manufactured goods depends on its expectation of profits to cover, at least, the research and development (R&D) costs of itsdifferentiated good as well as the costs of manufacturing it. In Melitz's model, there is free entry and exit of firms in an industry for developing and manufacturing each specific good, but profitability is highly uncertain because it depends on the unknown firm's total factor productivity (TFP). In a strategy to decide whether or not to develop and manufacture a new good, a firm estimates different levels of productivity, which are decomposed into expected productivities if all goods are for selling inthe domestic market, in foreign

markets or both. The decision to distribute part of the total production to foreign markets involves additional costs because the firm must face variable trade costs, such as transport costs, tariffs imposed by importing countries and other trade costs.

Despite not emphasising it, Melitz (2003) implicitly assumes Linder's hypothesis that larger domestic markets tend to generate higher levels of productivity than smaller ones. Thus, in his model, firm size matters for determining their corresponding level of productivity, in such a way that the largest firms, by being more able to draw gains from static economies of scale, have higher levels of productivity and major potential to export. In these circumstances, by integrating into the global markets, these firms tend to maximise their gains from productivity resulting from higher economies of scale and the expanded market. The impact of global trade integration is similar to that of Krugman's model: it puts each surviving firm's demand up, making it more elastic due to the joint effect of more competition and bigger market size. Although the mark-up of the largest surviving firms is reduced, they can increase their operating profits due to the effect of higher market shares.[17] However, as Melitz and Trefler (2012: 101) point out, "economic integration through market expansion does not directly affect firm productivity. Nevertheless, it generates an overall increase in aggregate productivity as market shares are reallocated from the low-productivity firms with high marginal costs to the high-productivity ones with low marginal costs". In other words, the increase in aggregate productivity results in a reallocation of resources within the industry.

As exports are not the only way of reaching global markets and since the majority of world trade in goods and services are driven by multinational firms, trade economists have also been modelling the possibility of firms to establish affiliates abroad. The three main cases are the vertical multinational FDI (foreign direct investment), which occurs when a multinational firm chooses to keep its headquarters in one country and production in another with the goal of

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[17] By comparing a situation that occurred pre-and-post a trade liberalisation reform, this only happens for firms that choose to produce and sell for both domestic and foreign markets after trade liberalisation reform. For firms that choose only to produce and sell in domestic markets, the operating profits are reduced due to the fall in prices resulting from foreign competition. For details, see Melitz and Trefler (2012:103-109).

taking advantages of factor price differences across countries in the world economy (Helpman, 1984); the horizontal multinational FDI, which occurs when a multinational firm decides to operate plants with specific fixed costs in multiple countries, which are chosen considering thedifferent transport costs betweenthem (Markusen, 1984; 2002); and complex integration, which occurs when multinational FDI combines both vertical and horizontal strategies in the world economy in such a way that, as summarised by Helpman (2011: 146-147), "subsidiaries of multinational companies sell their products in host countries and import intermediate inputs from parents firms. But they also export products to their parent countries as well as to third markets, to affiliated parties and nonaffiliated parties alike".

Since complex integration has been not only the most registered form of multinational FDI, but also the mechanism through which the global value chains are interconnected, it is worth analysing its main determinants. Helpman (2011:148) suggests "thinking about horizontal FDI, vertical FDI, and platform FDI as interrelated strategies".[18,19] A theoretical model is summarised as follows.[20] The world economy is represented by a set of big countries fromthe North (the United States, France and Germany) and small countries fromthe South (the Philippines, Vietnam and Indonesia). There are several intermediate inputs for production of a final differentiated good, and their location in each of the countries depends on different fixed costs of FDI in intermediate goods as well as the productivity levels of heterogeneous firms.

FIGURE 2:FDI STRATEGIES AND THE GENESIS OF GLOBAL VALUE CHAINS IN THE WORLD ECONOMY

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[18] For "platform FDI", Helpman (2011) refers to "the acquisition of subsidiaries whose purpose is to export their products to third countries (that is, not to the country in which the parent firm is located)".

[19] This suggestion is based on 2003 data on different strategies of US companies across the global economy. Helpman (2011: 148) documents that "while American companies operating in Greece were primarily driven by horizontal FDI considerations, since they exported back to the United States only 1 percent and to third countries only 8 percent of their total sales, in Ireland and Belgium investment was driven primarily by platform FDI. And in Malaysia and the Philippines, both vertical FDI and platform FDI played in important role".

[20] This theoretical model is a slightly modified model summarised by Helpman (2011, ch.6).
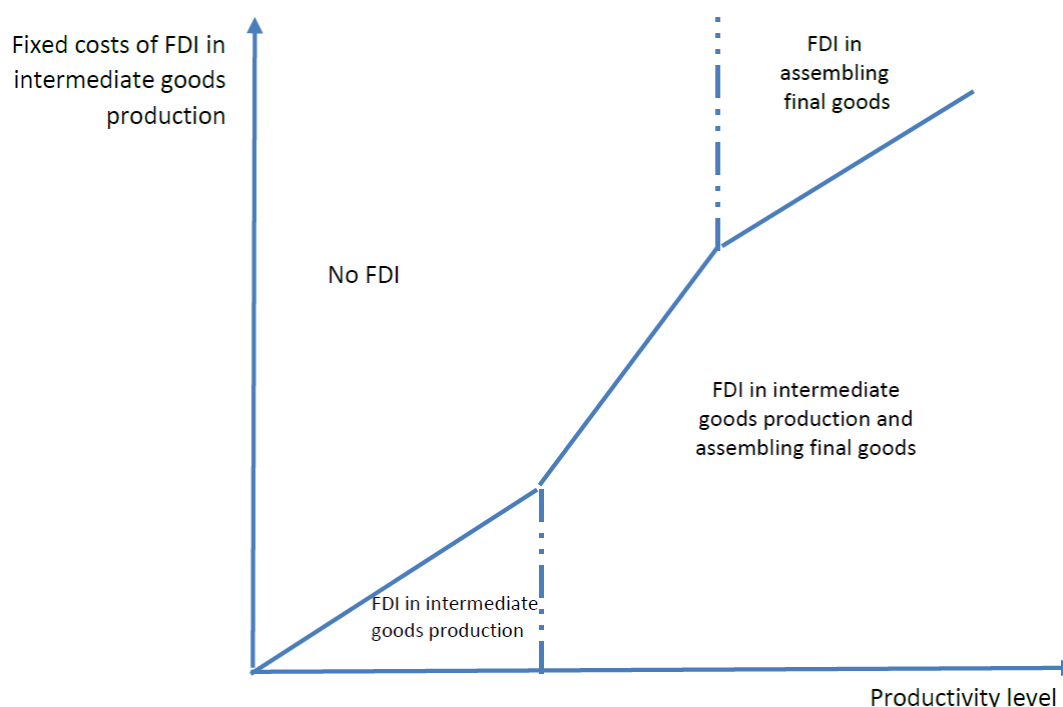
Source: Helpman (2012: 151)

Figure 2 illustrates the different strategies of FDI that generate and spread global value chains in the world economy. In the absence of transport costs and for a given fixed cost in assembling final goods,the first strategy occurs when higher fixed costs of FDI in intermediate goods production implies that neither FDI in assembly nor in production of intermediate goods in the South countries can be utilised by very low-productivity firms from the North. This is because they are unable to cover the fixed costs.The second strategy occurs when firmsfrom the North have high productivity levels that can offset high fixed costs of FDI.In this case, they are able to invest in both intermediates and assembly goods in the South countries.In the third strategy, the above-average-productivity firmsfrom the Northare able to engage only in assembling final goods in the South countries.They are unable to produce intermediate goods due to their extremely high fixed costs. In the fourth strategy, low-productivity firms can engage in FDI in intermediate goods in the South if, and only if, the fixed costs of their inputs are low enough to offset their low productivity levels.Although these models were designed to understand different strategies of multinational FDI pursued by the largest firms from North developed countries, they also clearly suggest that most firms from South

developing countries—beingcharacterised by smaller sizes—are hardly able to engage in FDI and create multinational enterprises.[21]

A Structuralist-Neoschumpeterian technological gap model: trade patterns and growth dynamics

As all the conventional models previously analysed assume that either factor endowment or technology is exogenous, both trade patterns and the gains or losses from trade are evaluated in static terms.Although few theoretical trade models are worried aboutthe dynamic impacts of free trade on countries' long-term growth, Grossman and Helpman (1991) on the Neoclassical front and Dosi, Pavitt and Soete (1990) on the Structuralist-Neoshumpeterian approach show consistent predictions about the countries'engagement in the global economy.In practical terms, the great challenge for developing countries characterised by large technological and productivity gaps in relation to developed countries is to evaluate the extent to which unconditional adoption of free trade policies could significantly reduce their long-term growth.This issue is clearly analysed by both Neoclassical (Grossman and Helpman, 1991) and Neoschumpeterian (Dosi, Pavitt and Soete, 1990) approaches. Despite their quite different methodological frameworks, they reach similar conclusions.[22]The most important cases are as follows. The first one is to consider the global economy composed oftwo countries that produce manufactured (the capital-intensive sector, subject to increasing returns to scale and product differentiation) and traditional goods (the labour-intensive sector that operates under conditions of constant returns to scale) and are completely similar in terms of endowments or technologies and accumulated knowledge. If thesetwo countries decide to integrate their markets through free trade practices, both could sustain the same long-term growth rates only and only if the same rate of

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[21] The obvious exception is (or tends to be) Chinese firms that operate in several industries, especially in manufacturing and service sectors.

[22] Among other aspects, while the Neoclassical Grossman and Helpman's (1991) model assumes several unrealistic hypotheses such as free entry in the research and development (R&D) sector (notwithstanding that it is subject to large increasing returns to scale) as well as treating technology as a service easily absorbed by firms through the knowledge transmission channels, Dosi, Pavitt and Soete's model (1990) gives up on the method of general equilibrium, refuses the idea that technology can be freely traded in domestic and global markets and accepts the assumption that the pattern of specialisation can have long-term cumulative (positive or negative) effects.

innovation is observed in both countries. Free trade benefits both countries by enlarging the variety of traded goods, but the net dynamic effect of global trade to long-term growth would be zero.

The secondcase is to considerthe global economy formed by two groups of countries that produce the above-mentioned kinds of goods: the first group is composed of the developed innovator countries characterised by high per capita income, high levels of aggregated productivity and technological capabilities close or equal to the technological frontier; the second group gathers all developing imitator countries characterised by per capita incomes close to the world economy average as well as significant technological and productivity gaps in relation to developed countries. Since these assumptions are closer to the reality of periphery countries like Brazil, we will briefly present a Structuralist-Neoschumpeterian model proposed by Cimoli and Porcile (2010),[23] who replicate more realistically long-term growth dynamics and implications of their engagement in free international trade.[24]

Cimoli and Porcile (2010) depart from Dornbusch, Fischer and Samuelson's (1977) Ricardian model of comparative advantage of a continuum of goods. We will adapt this model to a world composed oftwo groups of countries: theNorth innovator countries (N), specialised in the production of manufactures and services of high technological sophistication; and the periphery-South imitator countries (S), specialised in the production of primary and low-tech goods.Assuming that labour is the only factor of production, the static pattern of comparative advantage of the South imitator countries is ranked in a decreasing order:

$$\frac{a_1^*}{a_1} > \frac{a_2^*}{a_2} > \ldots > \ldots > \frac{a_n^*}{a_n} \quad (1)$$

where $a_n$is the labour requirement for producing a unit of good n and the symbol * refers to North innovator countries.Relative labour requirements are a

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[23] The basic model was firstly presented by Cimoli, Dosi and Soete (1986), Cimoli (1988) and Dosi, Pavitt and Soete (1990). In this paper, we will strictly follow Cimoli and Porcile's (2010) model.
[24]Even considering their quite different methodological approach, Grossman and Helpman's model (1991, ch. 9: 246-250) has similar results to the Cimoli and Porcile one presented afterwards. Yet, it is interesting that in his book entitled "Understanding the Global Trade", written without formalism with the goal of reaching a large audience, Helpman (2011) put aside the dynamic implications of an unconditional engagement in free trade for developing countries, especially lower long-term growth rates when their technological gap is large in relation to developed countries.

function of the technological gap. In other words, relative productivity of South countries is greater in the first a_n goods (because they require lower labour inputs), in our case, in primary and low-tech goods. Since the model is a continuum of goods, we can also rank them in a [0,1] interval according to a decreasing order of comparative advantage of South imitator countries, in such a way that:

$$A(z) = \frac{a^*(z)}{a(z)} \quad (2)$$

is a function in which good z is associated with each point in the [0,1] interval, with $A(z)$ continuous and decreasing in z, that is, the comparative advantage of periphery-South imitator countries to North innovator countries in industry z has a decreasing ranking, or A' (z) < 0.

　　With many goods, comparative advantage in each country depends not only on relative labour productivity, but also on relative wages between the two groups of countries *w/w**. Thus, the good z will be produced in the South countries if:

$$a(z)w \leq a^*(z)w^* \quad (3)$$

Rearranging (3), we obtain:

$$\frac{w}{w^*} \leq \frac{a^*(z)}{a(z)} \quad (4)$$

By defining:

$$\omega \equiv \frac{w}{w^*} \quad (5)$$

we obtain:

$$\omega \leq A(z) (6)^{[25]}$$

　　Given ω, South countries will produce (and so will have comparative advantage)[26] in the following interval of goods:

$$0 \leq z \leq \widetilde{z}(\omega) \quad (7)$$

　　Taking (6) as an equality, we can define the border for good z as:

$$\tilde{z} = A^{-1}(\omega) \quad (8)$$

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[25] Since Cimoli and Porcile (2010) assumed that wages are measured in nominal terms in both countries (according to their respective currencies), they had to consider the nominal exchange rate to put both wages in a common currency unit. However, for simplicity, we follow the original Dornbusch, Fischer and Samuelson's (1977) assumption according to which wages are measured in real terms (as units of required labour) in both countries.

[26] As is well known, the Ricardian model of comparative advantage predicts complete specialisation in such a way that all goods in which a country has comparative disadvantage will be produced by its trade partner. For details, see Krugman, Obstfeld and Melitz (2012, ch.3).

As A^{-1} is an inverse function of A (ω), the pattern of specialisation of Northinnovator countries will be concentrated in the interval:

$$\tilde{z}(\omega) \leq z \leq 1 \quad (9)$$

Figure 3 shows the structure of production and pattern of specialisation as a decreasing function of ω, the relative wage between South and North countries. A(z) is a decreasing curve because South countries lose comparative advantage as the economy moves towards goods of higher technological sophistication. Yet, ω is an increasing curve in z because as the South countries tend to diversify their economies, the rise in demand for labour implies an increasing of ω. Figure 3 suggests that an increase inwages in South countries relative to those inNorth countries will shift the ω to the left, reducing the set of goods produced and exported by the former group of countries.[27] Under conditions of perfect competition, comparative advantage depends simultaneously on relative productivities and relative wages between the two groups of countries. In such circumstances, Southimitator countries will have comparative advantages in all goods for which A(z) $>\omega$. In the world trade equilibrium, their production and export structures cover all goods from 0 to $\tilde{z}$, while the Northinnovator countries' ones cover the goods from $\tilde{z}$ to 1.[28]

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[27] In a comment on this result, Dosi, Pavitt and Soete (1990: 202) remind us that "it also applies in those cases where there are capital inputs and positive profits, provided that there is no 'reswitching of commodities'".

[28] Note that at the borderline $\tilde{z}$, as comparative advantage is the same for all groups, there is no international trade for this good.

FIGURE 3:STATIC PATTERN OF SPECIALISATION IN THE RICARDIAN MODEL WITH A CONTINUUM OF GOODS
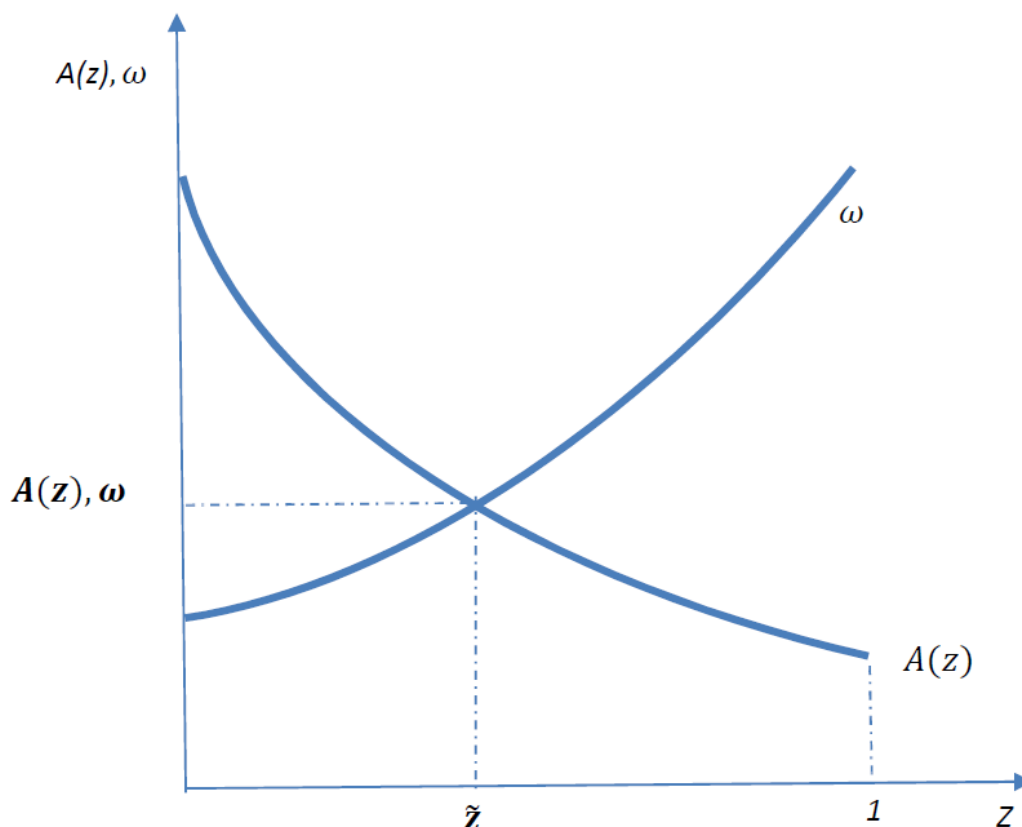
Source: Dornbusch, Fisher and Samuelson (1977: 825)

From this point on, differently from Dornbusch, Fischer and Samuelson's (1977) static model, which assumes labour market-clear conditions as well as homothetic preferences of the demand functions, we will consider Cimoli and Porcile's (2010) dynamic model through which both trade pattern and the effects on long-term growth are simultaneously determined. The following assumptions are implicitly introduced in the model:

i) Based on Engels's microeconomic laws, the *n* goods can show a wide range of price and income elasticities;

ii) Although there is only one factor of production (labour), the economic system is formed by workers and capitalists, who makethe initial financial funds required for contracting workers;

iii) All goods are produced under conditions of imperfect competition, in such a waythat the entrepreneurs fix prices according to a mark-up *m* on average labour costs. Thus, the set of goods z will be produced in Southimitator countries if $mwa_z < m^*w^* a^*_z$;

iv)   Since perfect competition is also removed from labour markets, the nominal wage is the result of bargaining between labour unions and entrepreneurs;

v)   Rather than labour constrained, capitalist economies are balance-of-payments constrained in the long run;

vi)   Given the state of technology, capitalist economies are generally below full employment; in the short run, economic activity depends on effective demand in the spirit of Keynes (1936);

vii)   In the long run, changes in technology are endogenously determined and affected by expected demand.[29]

By allying with the Structuralist view pioneeringly exposed by Raúl Prebisch (1950), Nicholas Kaldor (1966) and A.P. Thirwall (1979), Cimoli and Porcile (2010) present a model in which not only the pattern of specialisation, but also the pace of long-term growth are affected by the technological gap (TG), defined as the relative technological levels in Northinnovator (T_N) and Southimitator (T_S) countries, or[30,31]:

$$TG = \frac{T_N}{T_S} \geq 1 \quad (9a)$$

The dynamics of the technological gap is expressed by the following differential equation (the symbol ^ means change over time):

$$\widehat{TG} = \frac{d(\frac{T_N}{T_S})T_S}{dt}\frac{T_S}{T_N} = a - cTG - bz \quad (10)$$

The differential equation (10) suggests that the pace of the technological gap between South and North countries is influenced by the actual technological gap level itself (TG) and the degree of diversification of the economy, captured by the z produced goods. The parameter a is the autonomous component of the pace of the technological gap and is expected to be positive. While the parameter b captures the ability of South countries to imitate innovation (both in process and products) introduced by North countries,

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[29] Dosi, Pavitt and Soete (1990: 203), for instance, discard the possibility that technical progress can result from properties related to the steady-state equilibrium with "representative agents" and expectations according to "rational expectations".
[30] Most empirical studies used to take the relative average labour productivity between South and North countries as a proxy measure of the technological gap. In such cases, technological gap TG varies in the interval 0≤G≤1, as we will consider in the empirical section ahead.
[31] The remainder of this section rigorously follows Cimoli and Porcile (2010).

the parameter *c* represents the opportunities and challenges posed by the actual technological gap atany time. While the expected sign of parameter *b* is positive (the more diversified the economy in producing *z* goods, the more rapid the South will catch up with North countries), the expected sign of parameter *c* is twofold: in line with Gerschenkron's (1962)hypothesis, a positive *c* means that there are larger opportunities and challenges for South countries to reduce the technological backwardness in relation to North countries over time; however, contrary to Gerschenkron's hypothesis, a negative *c*, by meaning a sharp deterioration of relative technological levels, could imply the deepening of technological backwardness of South countries over time and make itharder to catch up.

The pattern of specialisation of the economy is also affected by the technological gap according the following equation (Cimoli and Porcile, 2010: 223):

$$\frac{a^*(z)}{a(z)} = A(z) = \gamma - \alpha TG - \beta z \ (11)$$

where γ, α andβ are positive parameters. This implies that if South countries aresuccessful in reducing their relative technological gap, the curve *A(z)* in Figure 3 would be shifted to the right, meaning more diversification of Southimitator countries towards a growing number of produced *z* goods.

To determine the growth dynamics in both groups, Cimoli and Porcile's (2010) model assumes no capital flows, in such a way that the current account in North and South countries must be in equilibrium. Since prices are formed by a mark-up rule ($p_z=mwa_z=mwL_z/y_z$; where *p* is the price of good z, *m* the mark-up, *w* the wage,$a_z$the labour requirement for producing a unit of good *z*, *L* the total labour force, and *Y*the nominal income related to each good z), total nominal income of South countries can be expressed as (and, symmetrically, total nominal income in North countries is related to the production of goods 1-$\tilde{z}$):

$$\int_{z=0}^{z=\tilde{z}} mwL_z dz = mw \int_{z=0}^{z=\tilde{z}} L_z \, dz = mwL \ (12)^{32}$$

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[32] The nominal income in production of each good *z* is defined *as* $p_z y_z = mwL_z$. In the aggregation, Cimoli and Porcile (2010: 228) assume that *m* and *w* are the same in all economies.

The current account equilibrium can be derived from the import demand functions in each group of countries (that is, the demand of North countries corresponds to South exports and vice-versa). If each good z has the same share in total nominal demand in North and South countries, the share of imports in total demand of the North and South will be, respectively, $(w^*m^*L^*)\tilde{z}$ and $(wmL)(1-\tilde{z})$.[33] Then, by combining these expressions, the conditions for current account equilibrium can be expressed as:

$$mwL = (\frac{\tilde{z}}{1-\tilde{z}})m^*w^*L^* \quad (13)$$

The relative South-North aggregate income Y_S/Y_N can be expressed as a function of the pattern of specialisation:

$$\frac{Y_S}{Y_N} = \frac{mwL}{m^*w^*L^*} = \frac{\tilde{z}}{1-\tilde{z}} \quad (14)$$

If $m = m^*$ and by rearranging (14), we can express the relative wage w/w^* as a function of relative production structures and employment levels:

$$\frac{w}{w^*} = (\frac{\tilde{z}}{1-\tilde{z}})\frac{L^*}{L} \quad (15)$$

By differentiating equation (14) with relation to time, we can obtain the long-term relative economic growth of the South countries:

$$\frac{\dot{Y}_S}{Y_N} = \frac{\dot{\tilde{z}}}{(1-\tilde{z})^2} \quad (16)$$

By multiplying and dividing the previous result by z^e, we obtain:

$$\frac{Y_S}{Y_N} = \frac{1}{1-\tilde{z}}(\frac{\dot{\tilde{z}}}{\tilde{z}}\frac{\tilde{z}}{(1-\tilde{z})}) \quad (17)$$

Expressing $\frac{Y_S}{Y_N} = \tilde{z}/(1-\tilde{z})$ and dividing both sides of (17) by $\frac{Y_S}{Y_N}$, we find the long-term relative economic growth rate of South countries:

$$\frac{\hat{Y}_S}{Y_N} = \frac{\hat{\tilde{z}}}{(1-\tilde{z})} \quad (18)$$

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[33] Remember that while the South produces all goods from 0 to $\tilde{z}$, the North produces all those from $\tilde{z}$ to 1 (or $1 - \tilde{z}$).

Equation (18) shows that the technological gap is reduced in Southimitator countries if and only if this group is successful in diversifying its productive structure. This occurs when $\hat{z} > 0$ and South countries can grow at greater rates than North countries.

The more interesting part of Cimoli and Porcile's (2010) technological gap model is when they consider a more realistic case in which goods z have different income elasticities of demand. The demand function expressed in equation (13) is replaced by another in which the share of goods in total expenditure rises exponentially with the number of goods z. Equation (13), the condition for currentaccount equilibrium in North and South (and remembering that South countries produce goods from 0 to $\tilde{z}$), is replaced by:

$$(mwL)^{1-\tilde{z}} = (m^*w^*L^*)^{\tilde{z}} \text{ (19)}$$

Expressing (19) in logarithms and differentiating both sides with respect to time (assuming m and m^* are constants), we obtain the dynamic condition for the current account equilibrium:

$$-\dot{\tilde{z}}\ln(mwL) + (1-\tilde{z})(\hat{w}+\hat{L}) = \dot{\tilde{z}}\ln(m^*w^*L^*) + \tilde{z}(\hat{w}^*+\hat{L}^*) \text{(20)}$$

As in equilibrium $z = 0$ and, therefore, $z = \tilde{z}$, we finally obtain the long-term dynamic growth rate of South countries relative to North ones:

$$\frac{\hat{Y}_S}{Y_N} = \frac{\hat{w}+\hat{L}}{\hat{w}^*+\hat{L}^*} = \frac{\tilde{z}}{1-\tilde{z}} \text{ (21)}$$

With such different specifications for demand functions in both countries, the result shown in equation (21) suggests two important conclusions: (i) the relative growth rate of South countries depends on their ability to diversify their economies, in such a way they will only be able to catch up with North countries if $\tilde{z} > 1/2$.; and (ii) since $\tilde{z}$ can also be interpreted as the income elasticity of demand for South exports (ε_X), and $(1 - \tilde{z})$ as the income elasticity of demand for South imports (π_M), equation (21) can be also be translated into the following expression:

$$\frac{\hat{Y}_S}{Y_N} = \frac{\varepsilon_X}{\pi_M} \text{(22)}$$

Equation (22) shows the so-called balance-of-payments constrained growth rate condition required by Thirlwall's law: the capacity of South countries to show growth rates aligned with their balance-of-payment equilibrium over time depends on the elasticity of demand for their exports beinggreater than elasticity of demand for their imports (see Thirlwall, 1979). If so, the South entered a catching up trajectory; if not, it entered a falling behind path. As Cimoli and Porcile (2010: 232) conclude:

"*The key role of demand growth is highlighted by this result. In effect, depending on how the demand function is defined, we have very different implications for economic growth with the same technological gap and pattern of specialization. The pattern of specialization is endogenous, supply-side (i.e. technology and productive structure) driven, but the demand functions define how a specific pattern translates into economic growth. At the end of the day, both the Schumpeterian and Keynesian sides of the growth equation must be taken into account in the model.*"

Empirical evidence: the case of Brazil

In thissection, we will analyze the evolution of the trade patterns of the Brazilian economy between 1990 and 2016. Throughout this period, Brazil experienced a process of trade liberalisation (1990-1994), the stabilisation of high inflation rates (*Plano Real*, 1994) and other liberalising economic reforms, such as privatisation of state enterprises, the liberalisation of the domestic financial system and the openness of the capital account, among others. This section is divided into two subsections: in the first, we will briefly analyse the main reforms introduced in Brazil in this period, with emphasis on trade liberalisation; in the second, we will show empirical evidence on the changes that occurred in the Brazilian trade patterns.

A brief analysis on Brazil's economic reforms and some previous indicators(1990-2017)

From the last quarter of the nineteenthcentury to 1930, the Brazilian economy was highly open to international trade and, despite the presence of a few infant low-tech industries, unable to show a vigorous industrialisation process.In this period, Brazilian productive and export structures were strongly concentrated on coffee and other primary products of low income and price-elasticity of demand. By depending onthe export performance of these goods in the global markets, long-term economic growth in Brazil was driven by world markets and constrained by price volatility of its main exports. At the same time, in the absence of a vigorous manufacturing sector, a significant share of manufactured goods was imported (Furtado, 1959).

The dramatic crisis of the Brazilian primary export sector resultingfrom the Great Depression of the 1930s put an end to the previous development model and was responsible for the spontaneous process of industrialisation based on import substitution (IS).[34] From the 1930s on, Brazil's long-term growth has been driven by the dynamism of the domestic market. However, the process of industrialisation only gained momentum after 1950, especially under Getúlio Vargas's second-term (1950–1954) and Juscelino Kubistschek's (1956–1960) governments, which adopted several protectionist measures in favour of infant heavy industries.[35]

From the mid-1950s to the beginning of the 1980s, industrial and trade policies maintained their essential elements. In each step of the IS process, governments targeted some industries as industrial policy priorities and combined high tariffs, import licenses and export subsidies (these latter especially after the 1970s) to protect the Brazilian manufacturing sector and boost exports of manufactured goods. In practice, the import license regime was only eliminated with trade liberalisation in March 1990.[36] Even consideringthe two attempts attrade liberalisation in 1966 and 1988, the

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[34] Furtado (1959).

[35] Tavares (1963).

[36]An import license as a sine qua non condition for an import to be approved lasted from 1947 to 1970, when the former was replaced by the "*guia de importação*" (an import document issued by the Foreign Trade Department, CACEX). Although the creation of this document has been justified for fulfilling statistical purposes, in practical terms it continued to work as an instrument of administrative import control. See Nassif (1995).

economy maintained a very high protectionist structure—at least when compared to that adopted by the Asian Tigers atthe height of their protectionist policies[37]—due to the prevalence of non-tariff barriers (NTB).[38]

Another peculiarity of the industrial policy in Brazil is that the country has always been open to foreign direct investment (FDI) driven by multinational enterprises (MNE). Policies for attracting MNEs in Brazilfocused on the implementation of import substitution and, hence, aimed at reducingboth technology and import dependencies (balance of payments issues).This contrastswith some Asian countries that were traditionally open to FDI, such as Singapore and China.These countries appliedmeasures that ensured the transfer of technology or technological spillovers to local firms. Therefore, Brazil was not able to draw upon the best techniques available in importantindustries of high and even medium technologies, such as capital goods, and chemical and automotive industries (Dahlman and Frischtak 1993).[39]

Although the protectionist policies have been marked by several drawbacks, such as the absence of selectivity, excessive national content requirements and the survival of rent-seeking activities throughout the period 1957-1980, there was a fine coordination between industrial and trade policies, in such a way that the latter was conditioned by the main goals of the several adopted National Development Plans. Despite all the imperfections of the protectionist policies of the IS period, there is no doubt that they created the conditions for developing a diversified manufacturing sector in Brazil over time.[40]

It is important to stress that, differently from some Asian countries (e.g. China and Taiwan), which sought to finance a significant share of gross investment with domestic savings, Brazil's development strategies—as well as most Latin American countries—were highly dependent on foreign savings, especially through long-term foreign lending, which, borrowed under conditions of flexible international interest rates, was the main modality observed from the

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[37] See Amsden (2001).
[38] Nassif (1995).
[39] As Amsden (2001:14) commented, "China, India, South Korea and Taiwan began to invest heavily in their own proprietary national skills. In contrast, Argentina and Mexico, and to a lesser extent, Brazil and Turkey increased their dependence for future growth on foreign know-how".
[40] For a comparison between interventionist policies and the process of industrialisation in Brazil and South Korea, see Moreira (1995) and Amsden (2001, ch.9).

1970s on. The shock of international interest rates in the 1979-1982 period led Brazil and several other Latin American countries to a deep crisis (the external debt crisis) that lasted until the beginning of the following decade.

In fact, the eruption of the external debt crisis in 1980, which led to the collapse in international private capital flows to Latin American countries in 1982, meant a complete disconnection between industrial and trade policies.These policies subsequently lost their most efficient tools for promoting catching up in Brazil. In fact, since a large amount of annual expenditureson external debt (principal plus interest expenditures) had to be paid, trade policies, especially import policy, became a powerful instrument for saving foreign exchanges—rather than being an industrial policy tool. The most infamous instrument for import control was the so-called Annex C, released by Brazil's Foreign Trade Department (CACEX), through which thousands of goods were prohibited in Brazil between 1980 and March 1990. In 1984, manufactured goods included in Annex C represented 46.8% of total tariff lines.In 1989, several goods of textile& clothing, footwear, plastic and motor vehicle industries still had import prohibition (Carvalho Jr., 1992). In practice, the long duration of such import control virtually meant infinite protection for the respective domestic industries.Despite a program of tariff reduction having been adopted in 1988, the prevalence of several non-tariff barriers implied that the effective protection in Brazil was practically unchanged (Kume, Piani and Souza, 2000).

The decision to introduce a unilateral trade liberalisation reform in Brazil between March 1990 and 1994 must be understood within this economic context. In such circumstances, the programme was designed with the goal of redesigning the structure of protection through the elimination of most non-trade barriers (NTBs), including the Annex C, as well as the reestablishment of the import tariff as the main instrument of protection forthe economy. Comparatively to other experiences of trade liberalisation in developing countries during the 1980s and the 1990s, the Brazilian trade reform represented a deep microeconomic shock for three reasons: first, it was concluded in a relatively rapid period of time (4 years), differently from South Korea and India, whose trade liberalisation reforms lasted around5 (from 1983 to 1988) and more than

10 years (from 1991 on), respectively;[41] second, contrary to the recommendations of trade liberalisation literature, the elimination of NTBs and reduction of import tariffs were jointly introduced, and trade reform was adopted together with the liberalisation of capital account as well as within a context of sharp overvaluation of the Brazilian currency;[42,43] and third, again, differently from South Korea and India, which preservedindustrial policy together with theirtrade liberalisation programmes as a strategy for pursuing catchingup, industrial policy practically disappeared fromthe government's policy focus in Brazil between 1990 and early 2000s, even after the conclusion of trade reform.[44]

Despite the negative microeconomic shocks, several studies show sound empirical evidence that between 1990 and 1998 labour productivity registered significant annual average growth rates in Brazil, reversing the low and stagnant annual average growth rates shown in the previous decade.Additionally, notwithstanding the use ofdifferent methodologies for measuring productivity, the labour productivity growth observed in the first half of the 1990s in Brazil was undeniable. In a panel data econometric model based on industrial plants, Nassif (2005), for instance, estimated that labour productivity in the manufacturing sector grew at 1.4% between 1988 and 1994, and 5% between 1994 and 1998.These results confirm similar empirical evidence of previous studies, which had also attributed such performance to the positive impacts of

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[41] Between 1989 and 1994, while the average nominal import tariff for all goods in Brazil was reduced from 39.6% to 11.2%, the standard deviation dropped from 14.6% to 5.9% in the same period. See Kume, Piani and Souza (2000:11).

[42] For Brazil and South Korea, see Moreira (1995). For Brazil and India, see Nassif (2003; 2007).

[43] For a theoretical discussion on how the speed and sequence of trade liberalisation reformsshould be designed, based on stylised facts of real experiences in Latin America and Asia, see Bhagwati (1978) and Michaely, Papageorgiu and Choski (1991). For the sequence of all economic liberalising reforms (trade, domestic financial system, capital account, etc.), see McKinnon (1991).

[44] In the case of South Korea, the clear change in priorities did not mean discarding industrial policy to promote structural change. According to the OECD (2012), "since the 1980s, the government carried out research and development (R&D) and gave incentives to the private sector for investing in R&D. By the 1990s, the chaebols (Korean conglomerates), were highly committed to R&D and the government widened the policy mix for R&D to include support to venture business in line with the rising demand from the private sector". The OECD (2012: 24) also documents that, by 2011, the Korean government maintained industrial promotion programmes for "leading industries", "strategic industries" and "infrastructure and business support". Yet India's governments never renounced industrial policy, which continued to be included in the 5-Year Plans after trade liberalisation in 1991 (see Nassif, 2007).

the Brazilian trade liberalisation.[45]Nassif (2003) and Kupfer (2005) showed, however, that such efficiency growth was mainly due to a labour shortage and the renewal of machine &equipmentthroughthe import of capital goods, rather than to technical change diffusion.

Table 1 gives an updated tariff structure for Brazil compared with other selected countries.

TABLE 1:TARIFF STRUCTURE IN SELECTED COUNTRIES (IN PERCENTAGE)

	Brazil (2017)	Russia (2016)	India (2015)	China (2015)	South Africa* (2015)	South Korea (2016)
Simple average tariff rate	11.6	8.3	13.0	9.5	8.3	14.1
WTO agricultural products	10.2	14.6	36.4	14.8	9.9	60.0
WTO non-agricultural products	11.8	6.5	9.5	8.6	8.0	6.6
Bound tariff lines (% of all tariff lines)	100	100	74.9	100	n.a.	90.1
Tariff quotas (% of all tariff lines)	0.4	0.4	n.a.	0.6	n.a.	1.9
Non-ad valorem tariffs (% of all tariff lines)	0.0	14.8	6.1	0.5	3.8	0.8
International tariff peaks (% of all tariff lines)	27.0	6.4	13.6	14.8	21.4	10.7
Minimum tariff for all applied tariff rates [1]	0.0	0.0	0.0	0.0	0.0	0.0
Median tariff for all applied tariff rates [1]	14.0	5.0	10.0	8.0	n.a.	8.0
Maximum tariff for all applied tariff rates [1]	41.3	80.0	150.0	65.0	55.0	800.3
Overall standard deviation of all applied tariff rates	8.4 [1]	10.3	16.5	7.5	14.1	44.1 [1]

Notes: * refers to Southern African Custom Union; 1: Data for 2014, calculated by Castilho and Miranda (2017); n.a.: not available. Source: World Trade Organization, Trade Policy Review, Several Issues.

Two conclusions can be drawn from Table 1. First, by comparing with some developing and developed countries,it is a myth to assert that Brazil is very close to being or is a protectionist country. The simple average tariff rate applied to all products (11.6%) in 2017 was lower than that of South Korea (14.1%) and India (13.0%).[46] The degree of dispersion of all applied tariff rates, measured by the standard deviation, is one of the lowest among the BRICS

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[45] See Hay (1997), Bonelli and Fonseca (1998), Rossi Jr. and Ferreira (1999), and Bonelli (2002).

[46] The simple average tariff rate on Brazilian imports in 2017 kept the same level registered at the end of the trade liberalisation programme in 1994. However, during this period, there were several modifications in the intersectoral and intrasectoral structure of protection in Brazil. See Kume, Piani and Souza (2000) and Abreu (2004).

countries (Brazil, Russia, India, China and South Africa) and much lower than South Korea, whose indicator was 44.1% in 2016. This suggests that the other applied tariff lines are not far from the simple average tariff line. These results do not match with Bonelli's (2015: 487, translated from Portuguese) assertion, according to which "Brazil is an economy with very few links to the international economy". In a similar line, Bacha (2016: 3, translated from Portuguese) comments that "Brazil is one of the most closed economies in the world". It is true that, by 2016, the share of trade flows (exports plus imports) in Brazil's GDP (18.3%) was verylow compared with middle income countries (38.6%) or countries like India (27.5%), whose economy is, however, more protected than Brazil, as Table 1 shows. However, Brazil's low degree of trade openness can be explained by the lack of competitiveness of manufacturing exports as well as the very low annual GDP growth rates (which imply low import volumes) observed in the last decades (only 2.4% between 1999 and 2016).[47]

Second, although the use of the international peaks coversa significant part of all tariff lines,[48] such peaks are in line with the Most Favourable Nation (MFN) tariffs negotiated multilaterally at the WTO. In any event, Brazilianeffective tariff rates estimated by Castilho and Miranda (2017) for 2014 (an average rate of 16.7% and a standard deviation of 15.2% for the overall economy) suggest that the structure of protection in Brazil should be reconsidered taking into account some distortions introduced by the high tariffs of some industries (e.g. transport equipment and some intermediate goods) as well as by modifications induced by protectionist lobbies or due to macroeconomic reasons.

From 2003 on, especially during Lula da Silva's (2003-2010) and Dilma Rousseff's governments (2011-2014), industrial policy returned as one of the leading mechanisms for promoting activities considered strategic for

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[47] The problem of the lack of competitiveness of exports will be discussed in the next subsection. Indicators on share of trade flows in GDP were drawn from the World Bank, World Economic Indicators. https://data.worldbank.org/indicator/TG.VAL.TOTL.GD.ZS. Accessed on 13 October 2017. Indicators on Brazil's annual GDP growth rates were drawn from the Brazilian Institute of Geography and Trade (IBGE), Quarterly National Accounts at 1995 constant prices. https://sidra.ibge.gov.br/pesquisa/cnt/tabelas. Accessed on 13 October 2017.

[48] Moreover, for the WTO, tariff peaks correspond to rates exceeding 15%. Other possible definitions take into account the tariff level and structure of the country. For instance, Castilho and Carvalho (2017) consider tariff peaks as the rates that exceed the sum of the tariff average and the standard deviation.

accelerating structural change towards scale-engineering-and-knowledge-based industries as well as diversifying productive and export structures, such as capital goods, software, information and communication technologies, pharmaceutical products, biotechnology, automobiles and others. In this period, three programmes of industrial policy were announced: Foreign Trade, Technological and Industrial Policy (PITCE, in Portuguese), in 2004; the Production Development Policy (PDP), in 2008; and Largest Brazil Plan (*Plano Brasil Maior*, in Portuguese – PBM), in 2011.[49] All these plans had as their core goal to boost physical investment and innovation in the Brazilian economy.

These plans, however, repeated old mistakes and well-known misleading policies that had prevailed during the time of the import substitution period: lack of selectivity and performance requirements from entrepreneurs who benefited from public incentives; an excessive use of public subsidies asthe main instrument of governmental support, especially credit subsidies from the Brazilian Development Bank (BNDES); and, last but not least, lack of coordination between industrial, trade and macroeconomic policies. One example of coordination failure is related to the recurrent trend of overvaluation of the Brazilian real. Figure 4 plots the behaviour of the real effective exchange rate (REER) in Brazil since 1988.[50]

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[49] For an analysis of PITCE and PDP industrial policies, see Coutinho etal. (2012). For details on *Plano Brasil Maior*, see the website of Brazil's Ministry of Development, Industry and Commerce (MDIC), http://www.mdic.gov.br/index.php/competitividade-industrial/politica-industrial/o-que-e-pbm-2 . Accessed on 12 October 2017.

[50] In Brazil, the exchange rate is defined as the domestic price of a foreign currency. So, while an increase in the exchange rate means a depreciation of the Brazilian *real*, a decrease means an appreciation of it. The real effective exchange rate was calculated by the Central Bank as a weighted average of the Brazilian *real* against a basket of currencies of Brazil's main trade partners, adjusted by the consumer inflation rate (IPCA).

FIGURE 4:BRAZIL: REAL EFFECTIVE EXCHANGE RATE (REER) – 1988 TO AUGUST, 2017 (INDEX-BASE = JUN-1994=100)

Source: Brazil's Central Bank

Figure 4 shows unequivocally that the overvaluation of the Brazilian real has been a recurrent trend since the early 1990s. The correction of such misalignments has only occurred after domestic or international shocks, such as the announcement of the stabilising Real Plan (*Plano Real*) in June 1994, the crisis of the electrical energy sector (*apagão*) in 2001, the electoral uncertainty during the transition from the presidency ofFernando Henrique Cardoso to Luiz Inacio Lula da Silva in 2002-2003, the aftermath of the 2008 global crisis and, finally, during the instability created by the impeachment of president Dilma Rousseff throughout 2015. After all these episodes, the Brazilian *real* has entered anew appreciation trend in real terms.In an econometric model seeking to identify the main forces that pushed the Brazilian real towards that appreciation trend in the period 1999-2015, Nassif, Feijó and Araújo (2017) showed that the favourable terms of trade and the sharp differential between Brazilian and international interest rates were the most significant explanatory variables.

Several studies have shown a strong correlation between the trend of overvaluation of the Brazilian *real*and the weak long-term economic

performance of the Brazilian economy, expressed by a sharp premature deindustrialisation[51]as well as low rates of productivity and economic growth. After having been positively impacted by trade liberalisation between 1988 and 1998, as previously discussed, the annual average growth rate of labour productivity in the Brazilian manufacturing sector has been stagnant and showed negative results between 1999 and 2015 (-0.2% p.y.).[52] With such a stagnant performance, it is not surprising to verify, according to Figure 5, that the technological gap of the manufacturing sector in Brazil (measured as the ratio of Brazil's labour productivity to the U.S. labour productivity), after having shown a slow catching up trajectory between 1970 and 1980, has tendentially widened outwards, as can be seen by the trend line.[53] Figure 5 also shows that the last period during which all segments of the Brazilian manufacturing sector significantly reduced the technological gap occurred in the aftermath of trade liberalisation, especially between 1990 and 1998, as we discussed earlier. Particularly, the science-engineering-and-knowledge-based industries, after having reached almost half of the technological frontier in 1997, entered a fallingbehind trajectory afterwards. Although these indicators have not been updated by ECLAC-PADI, such trends can hardly have registered significant changes inthe opposite direction, in the face of the stagnant behaviour of the labourproductivity growth in the manufacturing sector in Brazil in the last decade, as we commented earlier.

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[51] Several studies have attributed the real appreciation trend of the Brazilian currency as being one of the main causes of Brazil's premature deindustrialisation. See, for instance, Bacha (2013), Bresser-Pereira (2010), Nassif, Feijó and Araújo (2015) and Nassif, Bresser-Pereira and Feijó (2017).

[52] These results were calculated and kindly offered to the authors by Jorge N.P. Britto, from the Department of Economics at the Fluminense Federal University. The labour productivity was calculated as the ratio of the value of industrial transformation (a proxy for value added) to the number of employees directly occupied at production (these indicators are estimated, in turn, by the Annual Industrial Survey – PIA, from the Brazilian Institute of Geography and Statistics - IBGE). The numerator was deflated by sectoral Wholesale Price Indices (IPA) of Fundação Getúlio Vargas.

[53] These data are estimated by the Program for the Analysis of Industrial Dynamics (PADI) of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). Originally, the taxonomy of ECLAC is composed by natural resource-based, labour intensive and engineering-based manufacturing industries. As these latter industries also contain scale and science-based industries, we grouped all of them and renamed them as science-engineering-and-knowledge-based manufacturing industries.

FIGURE 5:TECHNOLOGICAL GAP IN THE BRAZILIAN INDUSTRIES OF THE MANUFACTURING SECTOR CLASSIFIED BY FACTOR CONTENT AND TECHNOLOGICAL SOPHISTICATION
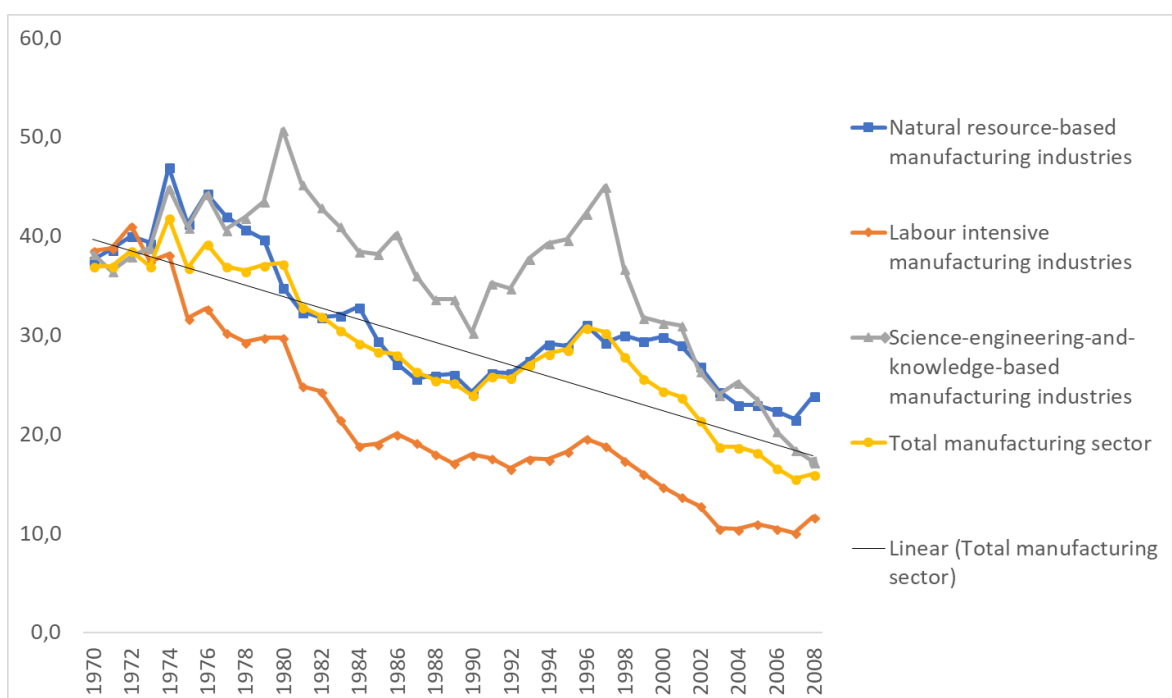
Source: ECLAC-PADI

The falling behind trajectory of the Brazilian economy can also be confirmed by the results of Thirlwall's law for the Brazilian economy between 1980 and 2010—see equation (22) in Section 2—, estimated by one of the authors in a previous paper (see Nassif, Feijó and Araújo, 2015), andsummarised inTable 2.

TABLE 2:THIRLWALL'S LAW AND THE FALLING BEHIND TRAJECTORY OF THE BRAZILIAN ECONOMY (1980-2010)

Period	Income-elasticity of demand for Brazilian exports (e_x)	Income-elasticity of demand for Brazilian imports (p_M)	Thirlwall's Law $\dfrac{Y_{Brazil}}{Y^*_{World}} = \dfrac{\varepsilon_x}{\pi_M}$
1980:3 – 2010:2	1.059	1.993	0.531
1980:3 – 1998:4	1.358	1.967	0.690
1999:1 – 2010:2	1.329	3.361	0.395

Note: 1, 2, 3 and 4 refer to quarters.Source: Nassif, Feijó and Araújo (2015: 1326)

According to Table 2, while between 1980 and 1998, Brazil's estimated annual average growth rate compatible with its balance of payments equilibrium was 69% lower than the world GDP growth rate, between 1999 and 2010, this

rate reduced significantly to only 39.5%, confirming the falling behind path in the decade.[54]

Brazil's trade patterns and the recent trajectory towards regressive specialisation

For Brazilian international trade, the period comprised between 1990 and 2016 was characterised by a strong dynamism. During these 26 years, the total trade value was multiplied by 6 while world trade was multiplied by 4. Brazilian exports attained US$336 billion and imports, US$246 billion.

The performance of Brazilian international trade was nevertheless very different during the 1990s and the 2000s. As shown in Figure6, not only was the growth intrade flows stronger in the 2000s but also the dynamics of exports and imports were opposite in the two periods. During the 1990s, after the Brazilian trade liberalisation and during the period marked by the overvaluation of Brazil's currency, imports grew at a faster pace than exports. From the 2000s on, Brazilian exports grew faster than imports, even thoughimports also increased significantly.

The Brazilian market share (total trade) evolved from 0.8% of world trade in 1990 to 1.4% in 2016.[55] During the 1990s, the Brazilian market share increase was pulled by the significant expansion of imports. The cumulated growth rate of Brazilian imports (148%) was twice the exports growth rate (75%) and well above the world trade growth rate (96%). From 2000 on, Brazilian exports grew faster than imports (236% and 147%, respectively) but both of them showed higher rates than global trade (119%). Therefore, Brazil reached its highest share in world trade inthis 25-year period for exports in 2011 (1.5%) and for imports in 2013 (1.3%). The different pace of the recent decrease inworld and Brazilian trade flows made the export market share recover to 1.4% (2016 data).

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[54] In another paper (Nassif, Feijó and Araújo, 2016), we estimated Thirlwall's law for all the BRICS (Brazil, Russia, India, China and South Africa) in the period 1995-2013. The results did not alter for Brazil and revealed that only China and India showed a catching up trajectory in the period.

[55] In a longer-term perspective, Brazilian exports attained their highest world market share during the 1980s (trade statistics are available from 1962 on). The market share average was 1.3% for the whole decade (lower than the period 2010-2016) but it attained 1.7% in 1984. On the other hand, the lowest average was reached during the 1990s, when Brazilian market share was 1.0%. From then on, the share has increased both in the 2000s and during the last period (2010-2016).

FIGURE 6: BRAZILIAN EXPORTS, IMPORTS AND MARKET SHARE EVOLUTION

(1990-2016)
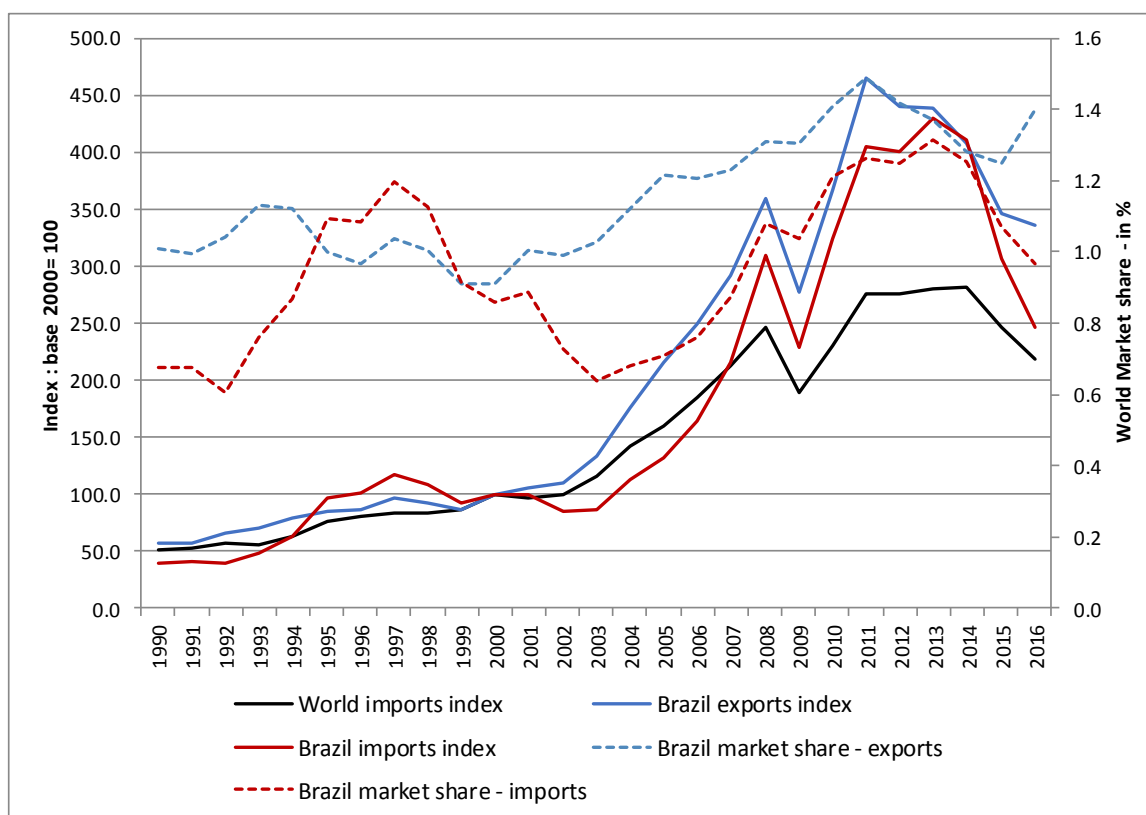
Source: Elaborated by the authors based on COMTRADE database.

In Table 3, trade flows were broken down into industries according to the relative use of productive resources (resource-based versus labour intensive) as well as the degree of technological sophistication,according to Pavitt's (1984) classic taxonomy (for sectoral classification,see Appendix 1). The strong increase in Brazilian trade flows over this period was accompanied by important composition changes, mainly on the export side. On the import side, the sectoral composition kept relatively stable, with the manufactured goods representing a large majority of imports. The most important change during the whole period was the reduction inoil imports in the first half of the 1990s as a consequence of the increase in the national oil production. After that, changes in import structure were minor, despite the increase inimports of labour and scale intensive sectors.[56]

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[56] The increase inlabour intensive imports was strongly influenced by the rise in textiles, clothing, shoes and some chemical goods, while the transport equipment imports (cars, trucks and ships) were the main reason for the share of scale intensive goods to increase.

On the export side, as stated, there were important composition changes. The share of manufactured goods in exports remarkably decreased, going from 78% of total exports in 1990-1995 to 53% in 2011-2016, while the share of primary goods in total exports increased from 21% to 45% in the same period. In fact, between 1990 and 2016 the shareof primary goods more than doubled and recovered the importance they used to have in exports in the beginning of the 1970s.This process has been named "export primarisation" and, as mentioned in section 3.1, several factors explain it, such as the commodities price boom in the 2000s due to the so-called Chinese demand-pull effect, the persistent overvaluation of the national currency and the dynamism of domestic demand for manufactured goods.[57] The primarisation process observed in exports was not, however, observed—at least not with the same intensity—in domestic production.In fact, Torracca (2017) shows the mismatch between the structure of exports and of domestic production. While primarisation is clear and strong in external trade flows, the domestic production structure is much more stable and less intensive in primary goods and resource based sectors, even though their share in domestic production increased. These conclusions do not contradict the evidence of premature deindustrialisation in Brazil, especially from the mid-2000s on. In fact, it is widely recognized that there has beena sharp reallocation of resources from the manufacturing sector to segments of low productivity in the tertiary sector in Brazil since the mid-2000s.[58]

All manufacturing sectors experienced a decrease in their sharein total exports at the beginning of the 1990s, except the science-based group (Table 3). The reduction in the share of manufactured goodsin total Brazilian exports is, in part, explained by the exceptional increase inprimary goods exports.[59]

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[57] See Bacha and Fishlow (2011), Bacha (2013) and Nassif, Feijó and Araújo (2017).

[58] In fact, according to the Brazilian Institute of Geography and Statistics (IBGE), the share of the agricultural sector in Brazil's GDP in real terms (1995 price) in 2016 was virtually the same as that of 1996 (6%). Yet, while the share of the manufacturing sector in total GDP was reduced from 13.8% to 9.8%, the share of the tertiary sector was increased from 57% to 60.7% during the same period. See https://www.ibge.gov.br/estatisticas-novoportal/economicas/contas-nacionais/9300-contas-nacionais-trimestrais.html?&t=resultados. Accessed on 25 October 2017. See Nassif (2008) for the 1947-2004 period (in current prices).

[59] The accumulated growth rate of Brazilian exports exceeded the rate of world exports for manufactured goods for the entire period 1990-2016 due mainly to the good performance between 2004 and 2013. Moreover, as shown by Castilho, Costa and Torracca. (2017), the export primarisation in Brazil has a very strong geographical character since exports to China, which became the first trade partner after the financial crisis, are very concentrated in primary and resource based goods.

TABLE 3: COMPOSITION AND EVOLUTION OF BRAZILIAN EXPORTS AND IMPORTS BY PRODUCT GROUPS (1990-2016)

	Primary goods	Resource based industry (1)	Labour intensive (2)	Scale intensive (3)	Specialized suppliers (4)	Science based (5)	n.d	Manufactured goods (1-5)	**Total**
				EXPORTS					
				Composition (% of total exports)					
1990-1995	21.1	28.5	12.6	23.0	9.7	4.0	1.0	77.9	100.0
1996-2000	22.4	27.3	10.6	21.1	9.8	7.2	1.6	76.0	100.0
2001-2005	26.4	24.2	9.2	20.4	9.1	8.8	1.8	71.8	100.0
2006-2010	36.8	22.3	6.3	17.2	8.1	7.2	2.2	61.1	100.0
2011-2016	45.1	21.2	4.9	14.5	7.2	5.2	1.9	53.0	100.0
				Average Annual Growth (p.y.%)					
1990-1995	5.4	9.7	7.7	8.2	10.7	5.6	10.3		8.2
1996-2000	5.0	(1.9)	2.3	2.3	1.5	29.2	11.4		3.5
2001-2005	23.4	13.9	10.4	18.5	17.7	7.9	15.2		16.5
2006-2010	21.6	11.3	1.6	1.9	4.7	3.5	11.6		11.2
2011-2016	(2.3)	(1.3)	(0.7)	0.9	(0.1)	(1.7)	(8.4)		(1.4)
				IMPORTS					
				Composition (% of total imports)					
1990-1995	20.7	22.5	7.6	14.4	18.8	15.9	0.0	79.3	100.0
1996-2000	12.6	20.5	8.7	16.3	21.8	19.9	0.1	87.2	100.0
2001-2005	15.5	18.5	7.8	14.2	21.3	22.6	0.0	84.5	100.0
2006-2010	14.4	19.3	8.4	17.7	19.0	20.1	1.2	84.4	100.0
2011-2016	11.2	21.0	9.7	19.2	18.7	20.2	0.0	88.7	100.0
				Average Annual Growth (p.y.%)					
1990-1995	(1.3)	25.3	33.2	38.2	**19.7**	19.1	39.0		19.1
1996-2000	(0.6)	(0.9)	(3.7)	(4.9)	**2.5**	9.0	48.2		0.7
2001-2005	13.1	2.1	5.5	6.5	**4.6**	5.0	(48.2)		5.7
2006-2010	10.7	22.3	22.9	27.7	**19.6**	16.2	105.5		19.7
2011-2016	(7.9)	(4.2)	(2.6)	(6.8)	**(4.7)**	(1.6)	(2.8)		(4.5)

Source: Elaborated by the authors based on COMTRADE database.

Among manufactures, labour intensive goods are the product group which lost more participation in exports since 1990 (from 13% to 5%), sincethe competitiveness of Brazilian goods in global markets significantly declined. Exports of scale intensive goods also showed aremarkabledecrease especially due to the reduction of steel products. The exports of science-based goods showed quite a dynamic trajectory till 2005, when theirshare in total exports began to retract. In 2016, their share (5.6%) was close to the average of the 1990s. Finally, despite the loss of around one quarter of their share in total exports, resource-based and specialised suppliers were the only categories which augmented their share in manufacturing goods exports.

The different export performances of the product groups are illustrated with annual data in Figure 7. While the reduction in the share of scale intensive,

labour intensive and resource-based goods began in the first half of the 1990s, specialised suppliers and science-based goods performed well for a longer time during the period 1990-2016. The highest export share of specialised suppliers was reached in 1996, and for science-based goods by 2000.

FIGURE 7: BRAZILIAN EXPORTS COMPOSITION BY PRODUCT GROUPS (1990-2016 – % OF TOTAL EXPORTS)
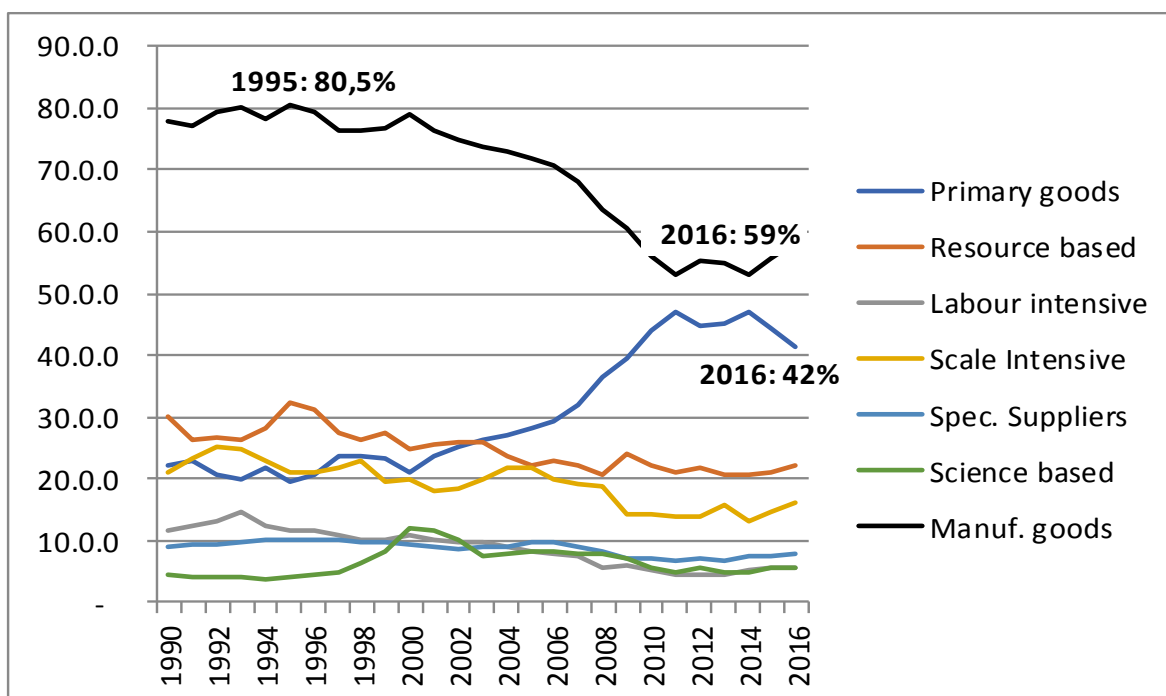
Source: Elaborated by the authors based on COMTRADE database.

Figure 8 displays the market share of Brazilian exports in total world exports. Despite the strong loss of importance of manufactured goods in Brazilian exports, their performance in world markets is less dramatic. In fact, the so-called primarisation process is partially explained by the commodities price boom and affected not only Brazil but also world exports. Figure 8 shows that, for manufactured goods, Brazil kept its (low) share of 1% in world exports until 2008. In terms of world market share, the product groups performed very differently. The labour-intensive goods are the only group presenting a net reduction from 1990 to 2016—a 25% loss of its world market share. Exports in science-based goods increased their share in world exports during the 2000s and decreased from 2009 on, reaching 0.4% at the end of the period. Scale-intensive goods reached their highest share in world markets in 2005, when from this year on their share kept floating around 1%. Specialised suppliers goods are the group with a more stable share during the period—around 0.6% over the 25 year period. Finally, resource-based goods, even showing a slightly decreasing tendency between 1995 and 2014, is the manufacturing sector with the highest share in the world market. Primary goods presented a completely different performance: their market share, after a decade of relative stability of

around 1.8% in the 1990s, was multiplied by 3.4 by 2016. Brazilian primary goods exports represented in that year 6.3% of total world exports.

FIGURE 8: MARKET SHARE OF BRAZILIAN EXPORTS IN WORLD EXPORTS, BY PRODUCT GROUP, (1990-2016, % OF WORLD EXPORTS)
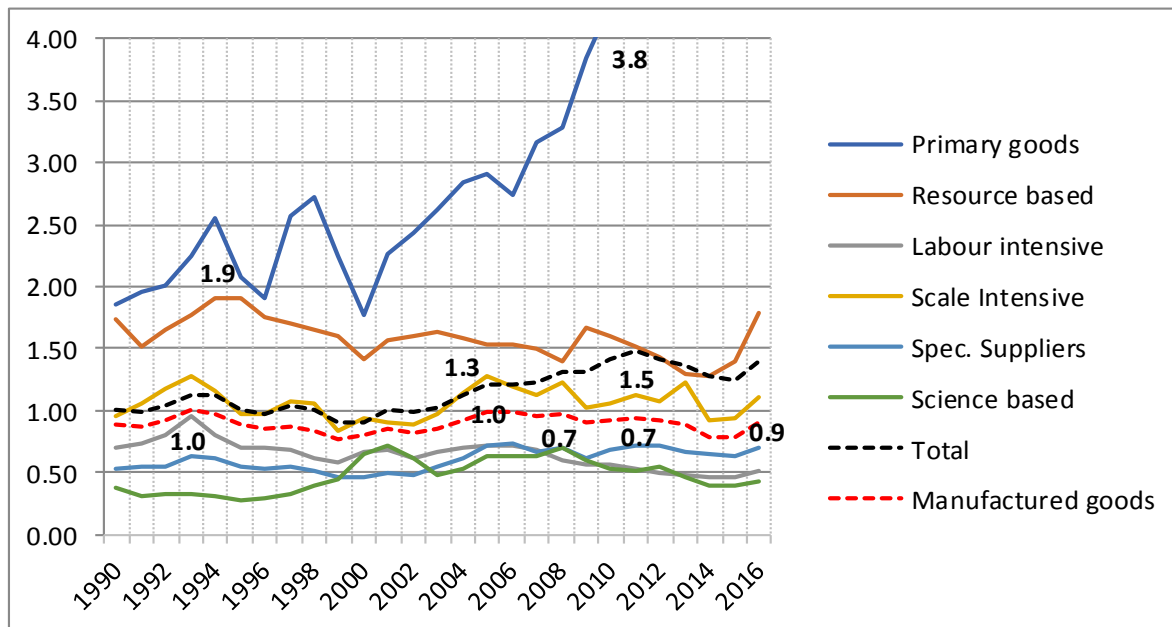
Source: Elaborated by the authors based on COMTRADE database.

A traditional indicator of a country's pattern of specialisation is Balassa's (1965) Revealed Comparative Advantage (RCA)[see equation A.1 in Appendix 2], whose results are shown in Figure 9.[60] Indicators clearly register a deepening of Brazilian export specialisation based on primary goods. Since it was accompanied by a continuous drop of the RCA of several manufactured goodscategories (notably,labour-intensive, science-based and specialised suppliers), these results characterise a regressive specialisation of Brazilian trade. Changes were stronger from 2000 on than over the 1990s.[61]

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[60]If RCA is above 1,that means the country has comparative advantage, whereas if RCA is below 1,that means absence of comparative advantage—or comparative disadvantage.

[61]These trends are also confirmed by Nassif, Feijó and Araújo's (2015) empirical study.

FIGURE 9: BRAZILIAN REVEALED COMPETITIVE ADVANTAGE
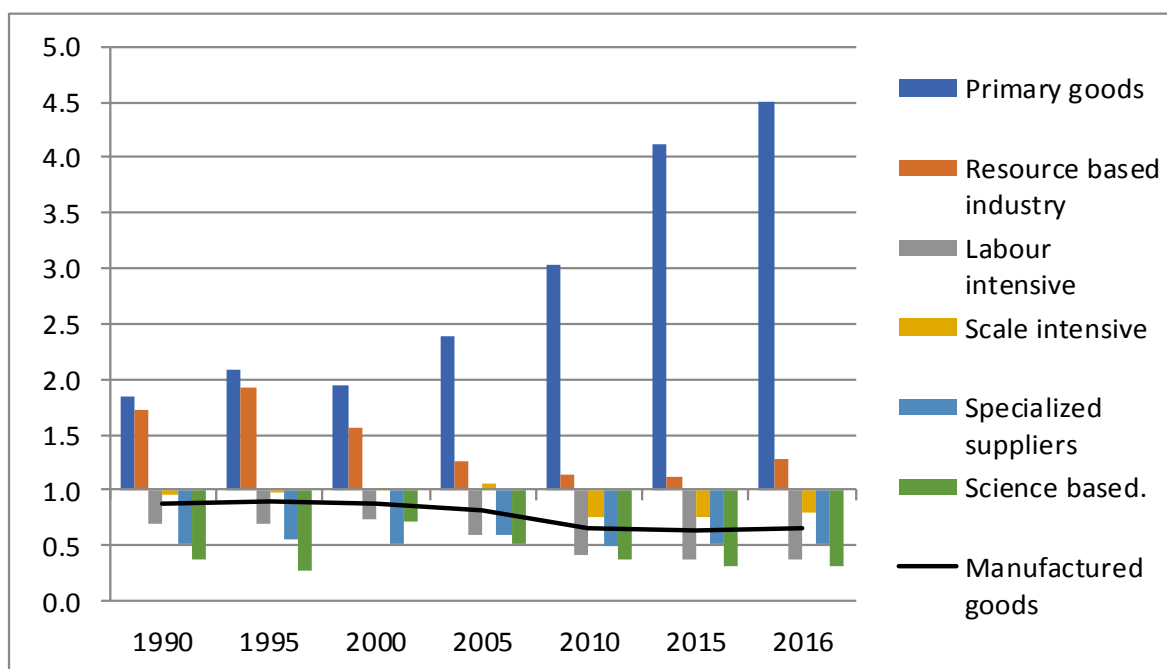
Source: Calculated by the authors based on COMTRADE database.

For analysing if, and if so the extent to which, Brazilian trade flows have been concentrated or diversified in the last decades, we used the Herfindahl-Hirschman index (HHI) as specified in equation A.2 in Appendix 2 and shown in Figure 10. As the HHI basically measures the degree of concentration (the larger the HH index, the more concentrated are the exports or imports), Figure 10 shows that Brazilian imports are currently more diversified than exports. The HHI also puts in evidence not only the difference inthe concentration degree of trade flows, but also the divergent trends in the last ten years. Exports have shown a concentration trend after 2004, while imports presented a stable evolution, after their diversification in the first half of the 1990s. The maximum level of export concentration measured by the HHI was reached in 2011. This latter result reflects theemergence of China as one of the most important Brazilian trade partnersafter the 2008 global crisis.In fact, Brazilian exportsgrew sharply and became extremely concentrated in mineral ores, soybeans and oil.[62]

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[62] These three products represent around 75% of Brazilian exports to China. As international prices of these commodities were very high until 2012, the share of these products in total exports rose remarkably.

FIGURE 10:DEGREE OF CONCENTRATION OF BRAZILIAN EXPORTS AND IMPORTS (HERFINDAHL-HIRSCHMAN INDEX, 1990-2016)
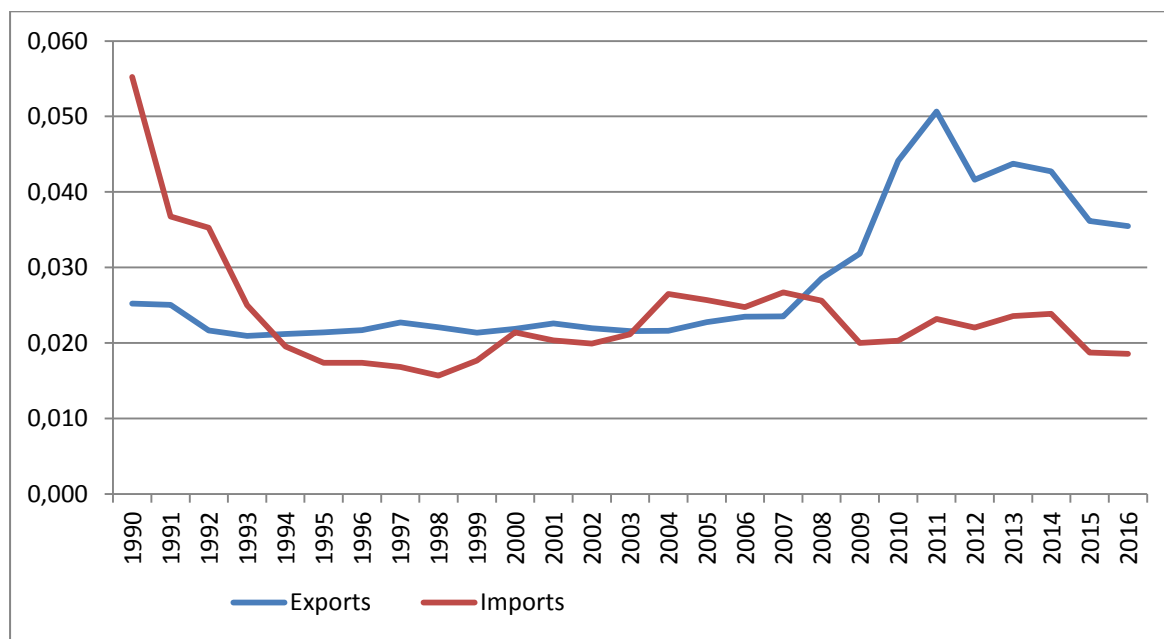
Source: Calculated by the authors based on COMTRADE database.

Table 4 shows the HHI for exports classified by factor content and technological sophistication. The major concentration changes occurred withthe science-basedgoods, -whichshowed the highest degree of export concentration by 2016. This was due to the high share of aircraft exports in this group.[63]The above mentioned "China effect"has clearly influenced the high concentration of primary and resource-based goods. The group of scale-intensive goods is the one that exhibited the moststabledegree of export concentration in the whole period.

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[63] Since 1990, airplanes havebeen the most important product in the science-based category. In the first half of the 1990s, theyaccounted for a quarter of this category's exports and reached 46% in 2016.

TABLE 4: CONCENTRATION OF BRAZILIAN EXPORTS, BY PRODUCT GROUP (HH INDEX, 1990-2016)

	1990	1995	2000	2005	2010	2016
Primary goods	0.186	0.181	0.156	0.149	0.181	0.149
Resource based industry	0.094	0.077	0.068	0.072	0.122	0.117
Labour intensive	0.126	0.107	0.110	0.097	0.099	0.116
Scale intensive	0.093	0.086	0.089	0.086	0.086	0.084
Specialized suppliers	0.129	0.079	0.087	0.089	0.081	0.086
Science based	0.190	0.090	0.331	0.223	0.192	0.250
TOTAL	**0.025**	**0.021**	**0.022**	**0.023**	**0.044**	**0.035**

SOURCE: CALCULATED BY THE AUTHORS, BASED ON COMTRADE DATABASE.

Another way of evaluating the degree of diversification is to measure the extent to which Brazil has exported old andestablished goods in the world markets (intensive margin) or new products and other goods with increasing share in world exports (extensive margin). The intensive (IM) and extensive (EM) margins were calculated according to the methodology proposed by Hummels and Klenow (2005) and are expressed byequations A.3 and A.4, presentedin Appendix 2.[64] The former corresponds to a country's market share of world exports in the products or categories in which itexports, indicating how consolidated the country isin exporting the same category of goods in the markets it traditionally acts in. The latter corresponds to the share of acountry's export basket in world exports through the diversification of exports in new categories of goods. The EM alsoaims at showing how important the country's export basket (or its 'portfolio') is for the world market.[65]

Figure 11 shows the IM and EM for Brazilian exports between 1990 and 2016.

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[64]There are other different definitions such as the one used by Amurgo-Pacheco and Pierola (2008) which identifies "old" and "new" import and export products and markets of a country by comparing the existence of trade flows with a reference period.

[65] According to Hummels and Klenow (2005), export growth can result from the expansion of exports of goods already exported or from a diversification process which corresponds to the "enlargement of the variety of exported goods" (p.3). The second source of growth is usually associated with monopolistic competition models based on Krugman (1981), whose main prediction is that big countries will produce and export a larger variety of goods.

FIGURE 11: EXTENSIVE AND INTENSIVE MARGINS OF BRAZILIAN EXPORTS (1990-2016)
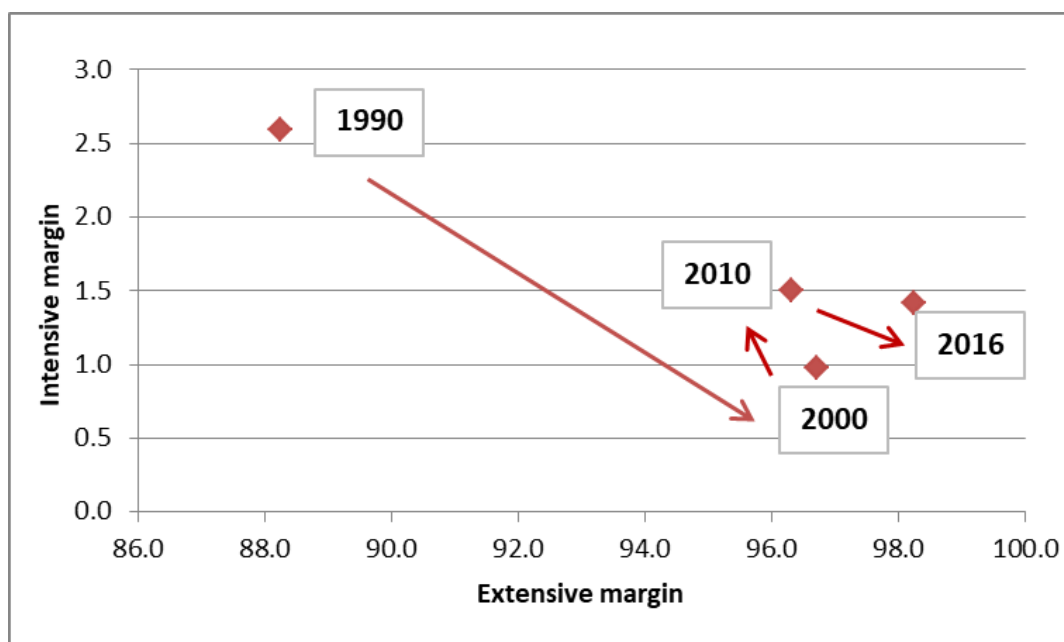
Source: Calculated by the authors based on Hummels and Klenow's methodology and COMTRADE database.

According to the figure, despite the loss of market share in the categories or goods that Brazil exports (intensive margin), its portfolio in new goods (extensive margin) has gained importance in world markets. This movement was very strong between 1990 and 2000, indicating that the loss of Brazil's market share in world markets was accompanied by a product diversification.[66] From 2000 on, despite a slight recovery of Brazil's export IM and a reduction of the EM until 2010, a trend of market share reduction together with a diversification of exported goods was observed in the last years.

The evolution of the EM may, at first sight, seem to contradict the results shown by the HHI index, which revealed a concentration trend of exports from 2007 on. In fact, the EM takes into account the range of the country's exported goods demanded by the world, and, therefore it is a measure of dynamism or adherence of the country's export basket to the world trade. In fact, Brazil has notably expanded the number of exported goods but, in terms of value in US

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[66]The number of products is an alternative way of measuring EM - see Carmo and Bittencourt (2014), for example. For this period, the number of products, defined at the 6-digit level of the 1992 HS classification, grew from 3.829 in 1990 to 4.263 in 2000 (out of a total of 5.036 products).

dollar, its exports have become increasingly concentrated in primary and other commodity goods.[67]

Table 5 shows the IM and EM for categories of goods classified according to factor content and technological sophistication. On the one hand, all product groups lost market share – for all of them, the IM reduced over the period. On the other hand, the EM increased for almost all groups during the period 1990-2016, except for science-based goods. The larger increases of the EM occurred for primary and resource-based goods, showing the dynamism of these groups, while the smaller changes took place in the more technologically sophisticated sectors – science-based and specialized suppliers. From the point of view of market share (IM), primary goods were the only group able to show significant market share gains in world markets. This was not the case of labour intensive and resource-based goods, which lost significant market shares during the period. These different sectoral changes suggest that primary goods revealed the best performance, with the recent recovery of its market share and a huge diversification.

TABLE 5: THE INTENSIVE (IM) AND EXTENSIVE MARGIN (EM) OF BRAZILIAN EXPORTS BY PRODUCT GROUPS (1990-2016)

	1990		2000		2010		2016	
	EM	IM	EM	IM	EM	IM	EM	IM
Primary goods	50.1	11.1	94.4	2.0	97.3	4.5	93.7	6.4
Resource based industry	77.9	5.2	89.9	1.6	87.6	1.8	96.8	1.7
Labour intensive	94.2	1.9	98.2	0.7	98.9	0.6	99.3	0.5
Scale intensive	94.4	1.9	98.1	1.0	98.8	1.1	98.9	1.1
Specialized suppliers	96.0	1.2	99.2	0.5	99.3	0.7	99.6	0.7
Science based	97.2	0.9	99.2	0.7	98.6	0.5	99.5	0.4
TOTAL	88.2	2.6	96.7	1.0	96.3	1.5	98.2	1.4

Source: Calculated by the authors, based on COMTRADE database.

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[67] To illustrate this point, we compared the EM, the number of exported goods and the share of the top 100 exported goods in Brazil, Argentina and the United States for 2016, using Comtrade exports data disaggregated at the 6-digit level of 2012 HS classification. The EM is over 90% for all these countries (92% for Argentina, 98% for Brazil and 100% for the United States), suggesting that these countries have a diversified export basket. The number of exported goods, however, is quite different, for each, corresponding to 69%, 84% and 99% for Argentina, Brazil and the United States, respectively, of the set of around 5200 goods. But the share of the top 100 exported goods in their total exports reveals a big difference in the degree of concentration in US dollar value terms: in Argentina and Brazil, the top exported goods represent,respectively, 85% and 78% of the value of their total exports, while in the United States this share is much lower – 47%. In other words, even considering that Brazil has a large number of different goodsin its export basket, in value terms its exports are quite concentrated.

As we analysed in Section 3.2 and as shown by Krugman's models (1979, 1980, 1981), the share of intra-industrial trade in total trade is usually larger among countries with similar development and income levels. And as this kind of trade is driven by scale-intensive and science-based industries, it is more dynamic and leads to gains for both partners due to the joint effect of higher competition and economies of scale. Depending on the level of statisticaldata disaggregation, intra-industrial tradesheds light on the degree of productive integration between countriesas well as the extent to which trade partners engage in regional and global value chains.

We measured Brazil's intra-industrial trade through the Grubel-Lloyd Index (GLI), as expressed by equation A.5 in Appendix 1 (see Grubel-Lloyd, 1971). As Reis and Farole (2012:35) suggest, the Grubel-Lloyd Index (GLI) is importantfor not only indicating the amount of intra-industrial trade (GLI equal to 1 indicates maximum intra-industrial trade), but also for capturing the degree of diversification within an industry (GLI equal to zero indicates absence of diversification within an industry).

Table6 shows GLI for Brazil between 1990 and 2016, which is estimatedusing data disaggregated at the 3-digit level of the STIC classification (240 products) and considers trade with all partners.[68]

TABLE 6: BRAZILIAN INTRA-INDUSTRY TRADE BY PRODUCT GROUPS (GRUBEL-LLOYD INDEX, 1990-2016)

	1990	1995	2000	2005	2010	2016
Primary goods	0.168	0.184	0.167	0.094	0.080	0.098
Resource based industry	0.136	0.217	0.256	0.257	0.199	0.212
Labour intensive	0.292	0.329	0.293	0.298	0.240	0.243
Scale intensive	0.231	0.328	0.302	0.268	0.319	0.324
Specialized suppliers	0.450	0.370	0.342	0.470	0.360	0.387
Science based	0.457	0.534	0.305	0.271	0.397	0.372
TOTAL	0.300	0.383	0.412	0.433	0.401	0.356

Source: Calculated by the authors, based on COMTRADE database.

The index of intra-industrial trade in Brazilian trade pattern is quite reduced (around 0.36).[69] After having grown between 1990 and 2007, the GLI

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[68]If from one hand, higher levels of product aggregation overestimate intra-industrial trade, on the other hand, if one intends to analyse geographical dimensions of this kind of trade (for regional integration studies, for example), it would be desirable to consider bilateral trade flows. For more details on these issues, see Fontagné and Freudenberg (1997).

[69] As several empirical studies show, the index of intra-industrial trade between some developed

showed a continuous reduction. The level and evolution of intra-industrial trade differ significantly betweengroups. As expected, the intra-industrial trade is more important for more elaboratedgoods or capital-intensive categories. As also expected, science-based, specialised suppliers and scale-intensive sectors are those with higher GLI due to their higher potential capacity to explore gains from economies of scale and product differentiation. The GL indices for science-based industries indicate that the intra-industrial trade rapidly grew in the middle of the 1990s, strongly decreased from the end of this decade onwards and vigorously recovered after the 2008 global crisis. Thisrecovery reflects larger trade flows within Mercosur, especially automobiles and airplanes.[70]While scale-intensive industries increased their GLI between 1990 and 2016, specialised suppliers and labour-intensive showed reductions. As expected, the primary goods and the resource-based groups show the smallest values for the GLIin the period.

Table 7 shows the composition of exports and imports according to Brazil's trade partners (1990 – 2016).Table 7suggests that Brazil can be classified as a "global trader" because of its large variety of trade partners. Overthe period1990-2016, there were some important changes in the geographical composition of Brazilian trade. First, its most traditional partners(the United States and the European Union (EU))[71]lost importance throughout this period. This reduction is stronger onthe export side of Brazil, while on the import side, the EU kept its share in the Brazilian market. Brazil's export share in Latin American countries increased during the 1990s, when they became a major destination for Brazilian exports. Mercosur was the main market responsible for this change, which is alsoconfirmed by the huge rise of Argentinean share both inexports and imports. After 2000, bilateral trade with Argentina declined, affecting Latin America'stotal trade. Even after this decline, Latin America remained as one of Brazil's most important partners, especially

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countries used to surpass 0.50. See, for instance, Ito and Okubo (2011).

[70] Mercosur is the custom union that joins Brazil, Argentina, Uruguay, Paraguay and Venezuela. Intra-Mercosur trade grew rapidly until 1997, with a notable share of intra-industry trade in automobiles and capital goods sectors. The intra-regional trade was so negatively affected by the 1998-1999 Brazilian crisis and the 1999-2001 Argentinean crisis that it was not returned to the 1990s level.

[71] Here we kept the 12 countries belonging to the EU in 1990 and that remained the main partners (more than 90% of EU27 trade).

on the export side. Anothermarked change in Brazilian trade was the increase of China's share in Brazilian trade after 2010. While in 2000, China's share for Brazilian exports and imports was around 2% of Brazil's total trade, this indicator jumped after the 2008 global crisis, reaching 19.2% and 17%, respectively, in 2016.

TABLE 7: GEOGRAPHICAL DISTRIBUTION OF BRAZILIAN EXPORTS AND IMPORTS

(1990-2016; IN PERCENTAGE)

	1990		2000		2010		2016	
	EXPORT	IMPORT	EXPORT	IMPORT	EXPORT	IMPORT	EXPORT	IMPORT
Latin America	11.0	12.5	24.8	21.7	21.6	15.3	19.5	12.1
Argentina	2.1	6.7	11.5	12.3	9.3	8.0	7.3	6.6
Mexico	1.6	0.9	3.2	1.4	1.9	2.1	2.1	2.6
United States	24.6	20.1	24.7	23.4	9.8	15.1	12.7	17.5
European Union 12	28.3	19.4	26.5	22.9	20.4	18.5	16.8	19.4
China	1.2	0.9	2.0	2.2	15.5	14.1	19.2	17.0
India	0.5	0.1	0.4	0.5	1.8	2.3	1.7	1.8
Japan	7.5	7.2	4.6	5.3	3.6	3.9	2.5	2.6
South Korea	1.7	0.4	1.1	2.6	1.9	4.7	1.6	4.0
Russia	n.a	n.a.	0.8	1.0	2.1	1.1	1.3	1.5
World	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Notes: n.a.: not available. Elaborated by the authors based on COMTRADE database.

Despite the fact that Brazil's trade with other countries (South Korea, Japan, Russia and India,as described in Table 8) is not as expressive as that with China and the United States, the data suggests that there was a geographical deconcentration of Brazilian exports and, albeit toa lesser extent, of imports. In fact, during the 2000s, trade with Asia and Africa grew and diversified, even taking into account thattrade with these two regions (except China) remained relatively weak.

The changes in geographical composition of Brazilian exports are reflected in the sectoral specialisation of the Brazilian export basket. In fact, Brazil's trade structure differs according to the stage of development of its trade partners and the specialisation of the partners. Bilateral trade can have a kind of North-South pattern of specialisation, as analysed in sections 2.2.1 and 2.3.That is, Brazil's trade pattern with the European Union and China is different from that with Mercosur or other neighbouringcountries. As shown by Castilho, Costa and Torracca (2017), in the last decade,the Brazilian export structure was strongly influenced by trade withChina,which is very concentrated in mineral and agricultural goods. In a simple simulation, they show that the share of

manufactured goods in Brazilian total exportswould be much higher if the China effect was not considered.[72]

Such differences are illustrated by Figure 12, which shows the change in Brazilian exports over time by partner, where the left axis refers tothe value in US dollars and the right axis indicates the share of each category exported in total goods exported to each region, represented by the black lines. We can clearlydistinguish two groups of partners. The first group is formed by very important markets for Brazilian manufactured goods exports—basically, Latin American countries and the United States. In 2016, Argentina and the United States were responsible for 94% and 84% of Brazilian total exports, respectively. The second group of partners is composed by theEuropean Union (EU-12) and Asian countries. The EU is one of Brazil's main trade partners and accounts for two thirds of total Brazilian exports of primary and resource-based manufactured goods. Of the total manufactured goods exported to the EU-12, 63% were related to intermediate goods.China's and Japan's shares for Brazilian manufactured goods exportsrepresented, respectively, 19% and 33% of the total in 2016. Among manufactured goods exports, there are also differences in composition: the importance of more technologicallysophisticated goods (science-based and specialised suppliers) differs significantly betweenthese two groups of partners. While forthe Americas (Latin America and the United States), such categoriesvariedfrom 18% (Argentina)[73] to 36% (the United States) in 2016, for the other group, the share is much smaller (3.5% for China, 8% for Japan and 11.4% for the EU).

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[72] As stressed by the authors, in 2013, China was responsible for 19.4% of total Brazilian exports. As 72% of the exports directed to China are from two goods: soybean and mineral ore (37% and 35% of bilateral exports, respectively), only the sale of these two goods to China represented 13.7% of total Brazilian exports in that year. The share of manufactured goods in a world "without China" would go from 62% to 73% in 2013.

[73] These shares differ especially from the earlier years. In the US case, we observed that the airplane exports inflated in the later years' statistics, and the share of these two categories became weaker in the earlier years. For LA, the share of these categories in the earlier years was higher, floating around 25%.

FIGURE 122: EVOLUTION OF BRAZILIAN EXPORTS BY SELECTED PARTNERS (1990-2016)
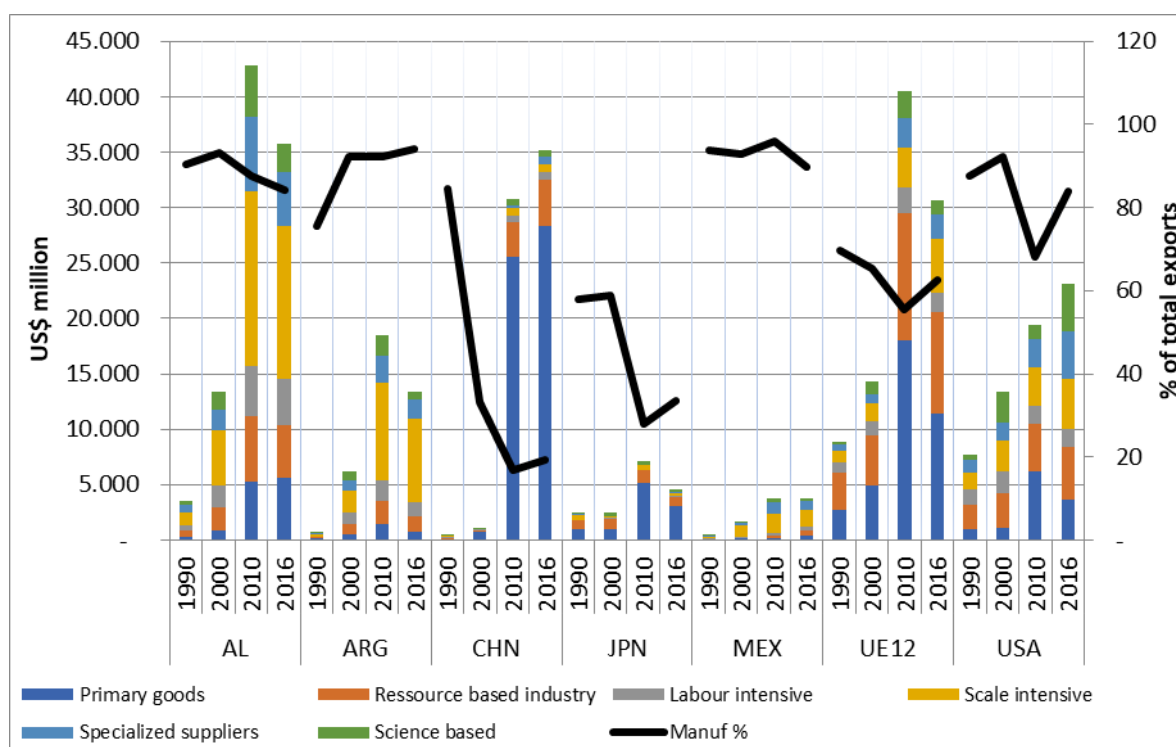
Source: Elaborated by the authors, based on COMTRADE database.

Brazil's pattern of trade specialisation as described above is typical of middle income level countries. In fact, as theoretical models of intra-industrial trade and technological gaps predict, trade patterns depend on a country's relativelevel of development and is highly influenced by the technological gap itself. These models suggest that developing countries tend to have a kind of "North-South" trade pattern with developed ones and an intra-industrial trade pattern of more technologically sophisticated goods with countries of similar per capita incomes. Brazil does not escape from this general rule. However, Brazilian trade pattern with the United States is quite surprising, since it is not characterised by a typically North-South kind,since trade in manufactured goods has been important in their bilateral trade in the last few decades.

Concluding remarks

This paper analysed the performance and composition of Brazilian trade flows in the last 26 years. Since most conventional theoretical models reviewed in this study, including the so-called "new new trade" models, take either technology or factor endowments as exogenous, they are insufficient to capture

some essential elements of developing countries' pattern of specialisation. In particular, as these countries are characterised by large technological and productivity gaps compared with developed countries, descriptive statistics indicators are insufficient to evaluate the extent to which unconditional engagement in free trade policies canpositively or negatively affect their long-term growth. The main contribution of Structuralist-Neoschumpeterian models is to show that the extent of a country's technological gap affects its pattern of specialisation and growth dynamics.Specifically, they predict that a country characterised by regressive trade specialisation haslow export diversification as well as income-elasticity of demand for its exports lower than income-elasticity of demand for its imports, implying a perverse long-term growth dynamics and compromising a virtuous catching up trajectory.

Empirical evidence on Brazil showed that since the early-2000s the technological gaps of the manufacturing sector (including natural resource-based segments) have significantly increased. In addition, as the income-elasticity of demand for Brazilian exports has become expressively smaller than the income-elasticity of demand for Brazilian imports after 1999, in comparison with the period 1980-1998, Brazil'sestimated long-term growth rate compatible with its balance of payments equilibrium has been much lower than the world growth rate. According to Thirlwall's Law (1979), such performance marks a falling-behind path.

The analysis of Brazilian trade pattern evidenced its regressive trade specialisation. Despite the significantincrease of Brazilian trade flows, the country'strade pattern did not show a virtuous trajectory between 1990 and 2016, especially with respect to the observed changes in the export structure. Whilethe import structure remained relatively stable, with the more technologically sophisticated sectors accounting for around 40% of Brazilian imports since the mid-1990s, the export structure was marked by a severe primarisationprocess.The export of primary goods continuedto increase its share in Brazil until 2014, even after the reversal of the commodity price boom from 2011 onwards.Among manufactured goods exports, labour-intensive and technologically sophisticated ones, such as scale and specialised suppliers, were replaced by primary and resource-based ones. The share of all resource-

basedsegments (primary and resource-based manufactured goods) more than doubled over the last 26 years, reaching 60% of Brazilian total exports in 2016.

This primarisationphenomenon was reinforced by a concentrationtrend of Brazilian exports.Although Brazil's ability to export new goods and diversify them for new markets (the extensive margin) increased for almost all categories of goods (except for science-based ones) between 1990 and 2016, these results did not imply a true diversification trend. Indeed, despite Brazil having notably expanded the number of exported goods, its exported value in US dollars, however, became highly concentrated in commodity goods in the same period.As to the geographical composition of trade flows, although Brazil can be considered a global trader because its trade relations are relatively diversified in the global economy, its bilateral trade patterns differ considerably according to the trade partners in terms of composition, diversification and degree of sophistication. While Brazil's bilateral trade with China, which became the most important Brazilian trade partner after the 2008 global crisis, is characterised by a typical "North-South" trade pattern, the Brazilian trade pattern with Latin American countries is radically different. By being characterised by sectoral complementarities and intra-industrial trade,this suggests a major potential for generating dynamic gains from trade between Brazil and Latin America.

Since Brazil had asharp regressive tradespecialisationin the last decades, such a trend has normative implications that go beyond the scope of this study. Notwithstanding, it is worth noting that appropriate industrial and trade policies finely coordinated with other economic policies (including the macroeconomic ones) are necessaryfor boosting productivity as well as changing this current regressive trade pattern into another characterised by diversification of Brazilian exports towards technologically sophisticated manufactured goods. This strategy could help put Brazil in a successful catching up trajectory.

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Appendix 1
Classification of Brazilian Industries according to Factor Content and Technological Sophistication (Correspondence between STIC Revision 2 and Pavitt's taxonomy)

STIC-Rev 2	ProductDescription	Product Categories (Pavitt Taxonomy)	Pavitt's Codes
001	Live animals chiefly for food	Primary goods	110
011	Meat,edible meat offals, fresh, chi	Primary goods	110
012	Meat & edible offals,salted,in brin	Primary goods	110
014	Meat &edib.offals,prep./pres.,fish	Primary goods	110
025	Eggs and yolks,fresh,dried or other	Primary goods	110
034	Fish,fresh (live or dead),chilled o	Primary goods	110
041	Wheat (including spelt) and meslin,	Primary goods	110
042	Rice	Primary goods	110
043	Barley,unmilled	Primary goods	110
044	Maize (corn),unmilled	Primary goods	110
045	Cereals,unmilled (no wheat,rice,ba	Primary goods	110
054	Vegetab.,fresh,chilled,frozen/pres.	Primary goods	110
057	Fruit &nuts(not includ. oil nuts),	Primary goods	110
071	Coffee and coffee substitutes	Primary goods	110
072	Cocoa	Primary goods	110
074	Tea and mate	Primary goods	110
075	Spices	Primary goods	110
121	Tobacco,unmanufactured; tobacco ref	Primary goods	110
211	Hides and skins (except furskins),	Primary goods	110
212	Furskins,raw (includ.astrakhan,cara	Primary goods	110
222	Oil seeds and oleaginous fruit,whol	Primary goods	110
244	Cork,natural,raw & waste (includ.in	Primary goods	110
245	Fuel wood (excluding wood waste) an	Primary goods	110
246	Pulpwood (including chips and wood	Primary goods	110
247	Other wood in the rough or roughly	Primary goods	110
261	Silk	Primary goods	110
264	Jute & other textile bast fibres,ne	Primary goods	110
265	Vegetable textile fibres and waste	Primary goods	110
291	Crude animal materials,n.e.s.	Primary goods	110
292	Crude vegetable materials, n.e.s.	Primary goods	110
273	Stone,sand and gravel	Primary goods	120
274	Sulphur and unroasted iron pyrites	Primary goods	120
277	Natural abrasives,n.e.s (incl.indus	Primary goods	120
278	Other crude minerals	Primary goods	120
281	Iron ore and concentrates	Primary goods	120
286	Ores and concentrates of uranium an	Primary goods	120
287	Ores and concentrates of base metal	Primary goods	120

288	Non-ferrous base metal waste and sc	Primary goods	120
289	Ores & concentrates of precious met	Primary goods	120
322	Coal,lignite and peat	Primary goods	130
323	Briquettes;coke and semi-coke of co	Primary goods	130
333	Petrol.oils,crude,& c.o.obtain.from	Primary goods	130
022	Milk and cream	Resource-based industry	211
023	Butter	Resource-based industry	211
024	Cheese and curd	Resource-based industry	211
046	Meal and flour of wheat and flour o	Resource-based industry	211
047	Other cereal meals and flours	Resource-based industry	211
048	Cereal prepar. & preps. of flour of	Resource-based industry	211
056	Vegetab.,roots& tubers,prepared/pr	Resource-based industry	211
058	Fruit,preserved,and fruit preparati	Resource-based industry	211
062	Sugar confectionery and other sugar	Resource-based industry	211
073	Chocolate & other food preptns. con	Resource-based industry	211
081	Feed.stuff for animals(not incl.unm	Resource-based industry	211
091	Margarine and shortening	Resource-based industry	211
098	Edible products and preparations n.	Resource-based industry	211
111	Non alcoholic beverages,n.e.s.	Resource-based industry	211
112	Alcoholic beverages	Resource-based industry	211
223	Oils seeds and oleaginous fruit, wh	Resource-based industry	211
248	Wood,simply worked,and railway slee	Resource-based industry	211
263	Cotton	Resource-based industry	211
268	Wool and other animal hair (excludi	Resource-based industry	211
411	Animal oils and fats	Resource-based industry	211
423	Fixed vegetable oils,soft,crude,ref	Resource-based industry	211
424	Other fixed vegetable oils,fluid or	Resource-based industry	211
431	Animal & vegetable oils and fats,pr	Resource-based industry	211
633	Cork manufactures	Resource-based industry	211
634	Veneers,plywood,improved or reconst	Resource-based industry	211
635	Wood manufactures,n.e.s.	Resource-based industry	211
642	Paper and paperboard,cut to size or	Resource-based industry	211
035	Fish,dried,salted or in brine ; smo	Resource-based industry	212
036	Crustaceans and molluscs,fresh,chil	Resource-based industry	212
037	Fish,crustaceans and molluscs,prepa	Resource-based industry	212
061	Sugar and honey	Resource-based industry	212
122	Tobacco manufactured	Resource-based industry	212
232	Natural rubber latex; nat.rubber&	Resource-based industry	212

251	Pulp and waste paper	Resource-based industry	212
641	Paper and paperboard	Resource-based industry	212
266	Synthetic fibres suitable for spinn	Resource-based industry	213
267	Other man-made fibres suitabl.for s	Resource-based industry	213
511	Hydrocarbons nes,& their halogen.&	Resource-based industry	213
513	Carboxylic acids,& their anhydrides	Resource-based industry	213
514	Nitrogen-function compounds	Resource-based industry	213
515	Organo-inorganic and heterocyclic c	Resource-based industry	213
516	Other organic chemicals	Resource-based industry	213
522	Inorganic chemical elements,oxides	Resource-based industry	213
523	Other inorganic chemicals	Resource-based industry	213
524	Radio-active and associated materia	Resource-based industry	213
681	Silver,platinum& oth.metals of the	Resource-based industry	213
682	Copper	Resource-based industry	213
683	Nickel	Resource-based industry	213
684	Aluminium	Resource-based industry	213
685	Lead	Resource-based industry	213
686	Zinc	Resource-based industry	213
687	Tin	Resource-based industry	213
688	Uranium depleted in u235 & thorium,	Resource-based industry	213
689	Miscell.non-ferrous base metals emp	Resource-based industry	213
971	Gold,non-monetary	Resource-based industry	213
334	Petroleum products,refined	Resource-based industry	214
335	Residual petroleum products,nes.& r	Resource-based industry	214
341	Gas,natural and manufactured	Resource-based industry	214
351	Electric current	Resource-based industry	214
269	Old clothing and other old textile	Labour intensive	221
572	Explosives and pyrotechnic products	Labour intensive	221
582	Condensation,polycondensation& pol	Labour intensive	221
583	Polymerization and copolymerization	Labour intensive	221
611	Leather	Labour intensive	221
612	Manufactures of leather/of composit	Labour intensive	221
613	Furskins,tanned/dressed,pieces/cutt	Labour intensive	221
621	Materials of rubber(e.g.,pastes,pla	Labour intensive	221
651	Textile yarn	Labour intensive	221
652	Cotton fabrics,woven	Labour intensive	221
653	Fabrics,woven,of man-made fibres	Labour intensive	221

654	Textil.fabrics,woven,oth.than cotto	Labour intensive	221
655	Knitted or crocheted fabrics	Labour intensive	221
656	Tulle,lace,embroidery,ribbons,& oth	Labour intensive	221
657	Special textile fabrics and related	Labour intensive	221
658	Made-up articles,wholly/chiefly of	Labour intensive	221
659	Floor coverings,etc.	Labour intensive	221
662	Clay construct.materials & refracto	Labour intensive	221
665	Glassware	Labour intensive	221
666	Pottery	Labour intensive	221
667	Pearls,precious& semi-prec.stones,u	Labour intensive	221
696	Cutlery	Labour intensive	221
812	Sanitary,plumbing,heating,lighting	Labour intensive	221
821	Furniture and parts thereof	Labour intensive	221
831	Travel goods,handbags,brief-cases,p	Labour intensive	221
842	Outer garments,men's,of textile fab	Labour intensive	221
843	Outer garments,women's,of textile f	Labour intensive	221
844	Under garments of textile fabrics	Labour intensive	221
845	Outer garments and other articles,k	Labour intensive	221
846	Under garments,knitted or crocheted	Labour intensive	221
847	Clothing accessories of textile fab	Labour intensive	221
848	Art.of apparel & clothing accessori	Labour intensive	221
851	Footwear	Labour intensive	221
883	Cinematograph film,exposed-develope	Labour intensive	221
892	Printed matter	Labour intensive	221
893	Articles of materials described in	Labour intensive	221
894	Baby carriages,toys,games and sport	Labour intensive	221
895	Office and stationery supplies,n.e.	Labour intensive	221
896	Works of art,collectors pieces & an	Labour intensive	221
897	Jewellery,goldsmiths and other art.	Labour intensive	221
898	Musical instruments,parts and acces	Labour intensive	221
899	Other miscellaneous manufactured ar	Labour intensive	221
961	Coin(other than gold) not being leg	Labour intensive	221
282	Waste and scrap metal of iron or st	Scale intensive	222
584	Regenerated cellulose;cellulose nit	Scale intensive	222
585	Other artificial resins and plastic	Scale intensive	222
591	Disinfectants,insecticides,fungicid	Scale intensive	222
592	Starches,inulin& wheat gluten;albu	Scale intensive	222
625	Rubber tyres,tyre cases,etc.for whe	Scale intensive	222
628	Articles of rubber,n.e.s.	Scale intensive	222
661	Lime,cement,and fabricated	Scale intensive	222

	construc		
663	Mineral manufactures,n.e.s	Scale intensive	222
664	Glass	Scale intensive	222
671	Pig iron,spiegeleisen,sponge iron,i	Scale intensive	222
672	Ingots and other primary forms,of i	Scale intensive	222
673	Iron and steel bars,rods,angles,sha	Scale intensive	222
674	Universals,plates and sheets,of iro	Scale intensive	222
675	Hoop &strip,of iron/steel,hot-roll	Scale intensive	222
676	Rails and railway track constructio	Scale intensive	222
677	Iron/steel wire,wheth/not coated,bu	Scale intensive	222
678	Tubes,pipes and fittings,of iron or	Scale intensive	222
679	Iron & steel castings,forgings& st	Scale intensive	222
691	Structures & parts of struc.;iron,s	Scale intensive	222
692	Metal containers for storage and tr	Scale intensive	222
693	Wire products and fencing grills	Scale intensive	222
694	Nails,screws,nuts,bolts etc.of iron	Scale intensive	222
695	Tools for use in hand or in machine	Scale intensive	222
697	Household equipment of base metal,n	Scale intensive	222
699	Manufactures of base metal,n.e.s.	Scale intensive	222
722	Tractors fitted or not with power t	Scale intensive	222
761	Television receivers	Scale intensive	222
762	Radio-broadcast receivers	Scale intensive	222
763	Gramophones,dictating,sound recorde	Scale intensive	222
774	Electric apparatus for medical purp	Scale intensive	222
775	Household type,elect.& non-electric	Scale intensive	222
778	Electrical machinery and apparatus,	Scale intensive	222
781	Passenger motor cars,for transport	Scale intensive	222
782	Motor vehicles for transport of goo	Scale intensive	222
783	Road motor vehicles,n.e.s.	Scale intensive	222
784	Parts & accessories of 722--,781--,	Scale intensive	222
785	Motorcycles,motor scooters,invalid	Scale intensive	222
786	Trailers & other vehicles,not motor	Scale intensive	222
793	Ships,boats and floating structures	Scale intensive	222
885	Watches and clocks	Scale intensive	222
233	Synth.rubb.lat.;synth.rubb.& reclai	Specialized suppliers	223
711	Steam & other vapour generating boi	Specialized suppliers	223
712	Steam & other vapour power units,st	Specialized suppliers	223
713	Internal combustion piston engines	Specialized suppliers	223
714	Engines &motors,non-electric	Specialized suppliers	223
716	Rotating electric plant and parts	Specialized suppliers	223
718	Other power generating machinery an	Specialized suppliers	223

721	Agricultural machinery and parts	Specialized suppliers	223
723	Civil engineering & contractors pla	Specialized suppliers	223
724	Textile & leather machinery and par	Specialized suppliers	223
725	Paper & pulp mill mach.,mach for ma	Specialized suppliers	223
726	Printing & bookbinding mach.and par	Specialized suppliers	223
727	Food processing machines and parts	Specialized suppliers	223
728	Mach.& equipment specialized for pa	Specialized suppliers	223
736	Mach.tools for working metal or met	Specialized suppliers	223
737	Metal working machinery and parts	Specialized suppliers	223
741	Heating & cooling equipment and par	Specialized suppliers	223
742	Pumps for liquids,liq.elevators and	Specialized suppliers	223
743	Pumps &compressors,fans& blowers,	Specialized suppliers	223
744	Mechanical handling equip.and parts	Specialized suppliers	223
745	Other non-electrical mach.tools,app	Specialized suppliers	223
749	Non-electric parts and accessories	Specialized suppliers	223
751	Office machines	Specialized suppliers	223
752	Automatic data processing machines	Specialized suppliers	223
759	Parts of and accessories suitable f	Specialized suppliers	223
771	Electric power machinery and parts	Specialized suppliers	223
772	Elect.app.such as switches,relays,f	Specialized suppliers	223
773	Equipment for distributing electric	Specialized suppliers	223
791	Railway vehicles & associated equip	Specialized suppliers	223
271	Fertilizers,crude	Science based.	224
512	Alcohols,phenols,phenol-alcohols,&	Science based.	224
531	Synth.org.dyestuffs,etc.nat.indigo	Science based.	224
532	Dyeing & tanning extracts;synth.tan	Science based.	224
533	Pigments,paints,varnishes & related	Science based.	224
541	Medicinal and pharmaceutical produc	Science based.	224
551	Essential oils,perfume and flavour	Science based.	224
553	Perfumery,cosmetics and toilet prep	Science based.	224
554	Soap,cleansing and polishing prepar	Science based.	224
562	Fertilizers,manufactured	Science based.	224
598	Miscellaneous chemical	Science based.	224

	products,n.e		
764	Telecommunications equip and parts	Science based.	224
776	Thermionic,cold& photo-cathode val	Science based.	224
792	Aircraft & associated equipment and	Science based.	224
871	Optical instruments and apparatus	Science based.	224
872	Medical instruments and appliances	Science based.	224
873	Meters and counters,n.e.s.	Science based.	224
874	Measuring,checking,analysing instru	Science based.	224
881	Photographic apparatus and equip	Science based.	224
882	Photographic & cinematographic supp	Science based.	224
884	Optical goods,n.e.s.	Science based.	224
911	UN Special Code	n.d	
931	UN Special Code	n.d	
941	Animals,live,n.e.s.,incl. zoo-anima	n.d	
951	Armoured fighting vehicles,arms of	n.d	

Appendix 2

Trade Indicators

Revealed Comparative Advantage Index (Balassa, 1965)

$$RCA = \frac{X_i^{BR}/X^{BR}}{X_i^{W}/X^{W}} \qquad (A.1)$$

Where: X_i^{BR} corresponds to Brazilian exports of product *i* and X^W corresponds to total World exports.

Herfindal-Hrishmann Index

$$HHI = \sum_{i=1}^{n}\left(X_i/X\right)^2 \qquad (A.2)$$

Where: X_i corresponds to exports of product *i* and X corresponds to total exports.

Intensive and Extensive margins of trade (Hummels and Klenow, 2005)

$$IM = \frac{\sum_{j\ni i}X_j^{BR}}{\sum_{j\ni i}X_j^{W}} \qquad (A.3)$$

$$EM = \frac{\sum_{j\ni i}X_j^{W}}{\sum_i X_i^{W}} \qquad (A.4)$$

Where: *j* is the sub-set of *i* goods exported by Brazil (that can be named as the *country's relevant export goods*); X_j^{BR} corresponds to Brazilian exports of the sub-set of products *j* and X^W corresponds to total World exports (X_j^{W} is the world exports of product *j* and X_i^{W} is the total world exports). The IM correspond to the market share of Brazil for its "relevant goods *j*". The EM is the share of *j* products in total world exports.

Intra-industry Trade Index (Grubel-Lloyd, 1971)

$$GLI = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i |X_i + M_i|}$$

(A.5)

Where: X_i and M_i correspond to a country's exports and imports of product *i*.
For avoiding aggregation bias, we employed the 6-digit Harmonised System disaggregation (around 5.000 product lines). Yet, trade flows are multilateral (not geographically disaggregated).