Trade, Protection and Competitiveness in Brazil: the case of the auto industry

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ABSTRACT

The question on why, when and how to impose tariff barriers to protect the domestic industry is far from settled. Although different branches of the literature acknowledge that the existence of market failures is a potential reason to protect, the identification and measurement of externalities, for example, is a very difficult empirical task. Thus, theoretical and empirical literature does not offer a satisfactory policy guidance.

However, it is not an assessment of potential market failures such as externalities that should guide policy. More can be said about the different channels through the link between tariff protection/trade liberalization and competitiveness operates. To shed light on these channels we undertake a case study of the Brazilian automotive sector, following an inductive approach and relying on different sources of both qualitative and quantitative data. In this, we ask "Why is the Brazilian Automotive sector not yet competitive after 60 years of protection?".

The identified channels that could answer our research question can be divided into (i) actions and policies that affect the internal and external scale of domestic production; (ii) variables affecting competition and productivity; (iii) variables affecting the production and absorption of innovation; (iv) institutional aspects and the business environment faced by firms operating domestically.

The results indicate that the structure of protection within the domestic value chain – namely the level of protection for intermediate goods, and the overall business environment, are two relevant aspects potentially affecting the long-term competitiveness of industrial sectors, and that these should be better taken into account in policymaking.

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CHAPTER 1- INTRODUCTION

1.1 OBJECTIVES, MOTIVATION, AND WHERE THE THESIS FITS INTO THE LITERATURE

What are the implications of trade liberalization for industrial growth and development? Alternatively, how does protection against foreign competition affects the path of economic development? Although these broad questions have been asked for decades, answers are still incomplete and very dependent on a vast number of assumptions and case-specific conditions: “There is no determinate theoretical link between trade protection and growth once real-world phenomena such as learning, technological change, and market imperfections (here captured by a learning-by-doing externality) are taken into account” (Rodriguez and Rodrik, 2000, page 272). As economic theory is not able to provide a clear guidance, policymaking can be bending too much towards political considerations – with all the associated risks of capture, rent-seeking, short-termism, and populism. Nonetheless, there is also room for empirical arguments defending protection without those reprehensible political motives: Salazar-Xirinachs, J., Nübler, I. and Kozul-Wright, R. (2014), for example, state that all countries that achieved success in their industrialization process made use of some type of selective industrial policy but acknowledge that excessive protective tariffs can be detrimental.

Given all these arguments, there is a clear scope for research aiming to clarify the theoretical landscape on the effects of protection (or trade liberalization) on growth, competitiveness and development.

This thesis fits into the broad theoretical debate about the relationship between international trade and growth, and also in the subset that brings together insights from

Industrial Organization and International trade literatures. To gain insights on how international trade affects growth we focus on trade protection and liberalization through tariffs, and its effect on productivity and competitiveness, through the main channels indicated by the literature, notably scale, competition, and access to technology. We also extend this analysis to include the debate on how institutions and the business environment could potentially affect not only competitiveness, but also modify a country`s comparative advantage. The thesis encompasses the trade-related industrialization process, but also touches on the discussion of a more service-based and technology-driven economy, thus analysing how the theoretical and empirical conclusions on the sources of industrial competitiveness and classical comparative advantages could be amended to explain more recent trends in automation and in the distribution of value added among firms and nations.

Rodriguez and Rodrik (2000) pointed to many flaws in the previous empirical studies that had supported a positive link between trade liberalization and long-term economic growth. Since them, progress has been made, and Irwin (2019) surveyed the following strands of the more recent empirical literature on the subject, that arguably tried to correct the mistakes pointed out by Rodriguez and Rodrik:

a) Cross country regressions;
b) Studies using methods of synthetic control, to build a counterfactual to analyse specific trade reforms;
c) Case studies that analyse the channels that may link trade reform and increases in productivity, including the channel of tariff reduction for intermediate goods.

Our work fits into this last group, a case study: our thesis is a case study of the Brazilian automotive sector, taking an inductive approach and using a mixed-methods methodology.

Although Irwin`s survey pointed to an average positive impact of trade liberalization on growth, there are important questions still needing answers on how the different channels potentially involved in this relationship operate. The examination of detailed channels by which trade can affect competitiveness, under the combination of market structures with firm-level heterogeneity, imperfect competition (monopolistic and oligopolistic) and externalities, is still at the frontier of the literature, as previous assumptions are revisited and new microeconomic empirical results shape our understanding. As an example, De Loecker and Biesebroek (2018) stress three other important questions still in need of more empirical evidence and clarification, that we intend to tackle in this research: a) although it makes sense to think that trade liberalization increase the size of markets and thus increase competition, the existence and the size of this channel still raises questions among the literature; b) the effects of trade liberalization on productivity and welfare, usually seen as a result of competition eliminating the less productive firms (thus raising average productivity) and also promoting a better allocation of resources towards the more productive ones, can be affected by the distribution of market power among heterogenous firms: the foreign firms can increase their mark-up after trade liberalization, thus reducing the pro-competitive effects of this liberalization[1]; c) how the access to imported input goods can be a source of market power; d) the relative importance of domestic and foreign competition.

Moreover, a combination of insights from the Industrial Organization literature and the Trade literature has been pointed as necessary at least since the 1980s, as stressed by Krugman (1995)[2]. The literature on these interactions is evolving, but still has a long way to go, to further clarify the relationship between trade and economic performance in general and firm performance in particular. In this sense, De Loecker and Biesebroek (2018) stress that firm performance can be the result of a combination of productive efficiency and market power, and thus these two aspects need to be studied together, to provide meaningful measures of the impact of trade openness, for example. As the authors correctly point out, only under perfect competition, when there is no market power, would estimates of productivity reflect the efficiency of firms, for example. In an imperfect competition world, firms can gain productivity by means of

[1] This argument is analysed in Arkolakis, C., A. Costinot, D. Donaldson, and A. Rodriguez-Clare (2019), who explain that although it is well understood that trade distortions can affect the welfare gains of trade liberalization, as for example in Bhagwati (1971), most of the literature analysing the impact of trade openness on firm-level mark-up focus only on domestic producers, thus missing the point that firms could have variable mark-ups and maybe foreign producers could increase their mark-ups following the trade liberalization, as they do not need to compress their margins to overcome trade tariffs anymore, when exporting to the domestic market.
[2] "if there is an overriding conclusion from the last 15 years of research it is that international trade theory is also international industrial organization" (page 1274). Krugman, P. (1995).

increasing market power, for example, and not necessarily because they became intrinsically better in producing a good or service.

Another motivation for this study is given also by the recent trend of renewed protectionism, led by declarations and actions from the United States, the country with the biggest Gross Domestic Product (GDP), measured at market exchange rates, in the world. The signs of a “trade war” between the United States and China, the biggest GDP measured at purchasing power parity, are alarming the world and such a dispute could endanger world growth. A final motivation relies on the personal experience of the author, who participated in several policymaking decisions related to industrial and trade policies in Brazil between 2005 and 2015.

1.2 CONTEXT AND POTENTIAL CHANNELS

The level of protection can affect industrial productivity levels and growth, as well as innovation, costs, and quality, either increasing them or decreasing them. If we consider all these indicators as part of the concept of dynamic competitiveness, we could say that the level of protection has an impact on the dynamic competitiveness of an industry. This is regardless of any consideration of externalities. Thus, even without measuring externalities we need to be sure that policies are promoting the dynamic competitiveness of the domestic economy. For this, we need to focus on the channels where the levels of trade protection can impact dynamic competitiveness. According to the economic literature, this impact can operate through effects on competition, on the ability to develop or adopt technology, and on scale of production. Moreover, other factors not necessarily related to trade can affect dynamic competitiveness, as, for example, institutions and the business environment.

The channels are not straightforward: scale can be viewed as a consequence of the first two channels: protection could promote industry scale through barriers against foreign competition, and, if associated with barriers to domestic competition, also promote firm-level scale. On the other hand, both industry and firm-level scale could be increased through specialization, with less protection. The effects on competition and on technology access link into productivity, quality, innovation and scale, with potential vicious or virtuous circles. Moreover, less discussed channels can also play a decisive role. This is the case of the effects of protection levels on the need and on the desirability of better business environments. Moreover, the nature of technology itself can change the results: as industry is being transformed by the so-called digital revolution, effects on scale, competition and access to technology can be fundamentally altered.

As there are many potential channels, this analysis would already be challenging. If we consider that these channels can interact among themselves, and, also, interact with country-specific conditions, the potential results are multiplied. In this sense, it would be more an empirical, than a theoretical debate. However, as cumulative empirical results are the way to increase or decrease the acceptance of theories, valid empirical results can contribute to the theoretical debate.

Our case study is the Brazilian automotive industry, actively manufacturing since the 1950s, after a long period of import Substitution Strategy. It was ranked 9th worldwide in terms of car production in 2016, but its production is heavily towards the domestic market, and the industry still relies on relatively high protective tariffs to avoid competition from imports. The fact that almost all automakers operating in the country are foreign multinationals[3] (and most of the tier 1 suppliers)[4] adds to the specificities related to technology transfer. Finally, although the size of the domestic market is usually viewed as the main reason for the existence of such industry, the country is characterized by a substandard quality of business environment.

The economic literature provides a vast array of theoretical models and potential arguments for and against trade protection. Each model or explanation has different assumptions and focus on a different set of potential channels/mechanisms. Apart from the possibility of numerous different theoretical results, the debate usually

[3] The brands are all multinationals, but there are Brazilian-owned automakers, such as CAOA, manufacturing under licence.
[4] In the 90`s, following the trade openness of the Brazilian economy, some of the biggest Brazilian-owned tier 1 autopart suppliers were acquired by foreign firms. However, there are still domestic-owned tier 1 firms, who became important players also in foreign markets, as Iochpe-Maxion (wheels manufacturer), for example.

sometimes stops at the validity of these assumptions. Even when there is a clear theoretical base and the assumptions are agreed, it may simply be that political economy considerations are more important, as the settling on small levels of protection can be viewed as politically difficult, especially within developing countries. In this sense, the debate that reaches policymakers is usually between the two extremes of complete free trade and high levels of generalized protection across the entire economy.

Although the increasing availability of empirical evidence provided a test for the entire spectrum of arguments, pro and against protection, the empirical literature on the effects of trade liberalization on growth is also conflicting and its results are subjected to all sorts of criticisms. The conclusion from the empirical evidence found in the literature could be summarized this way: import substitution strategies without a credible commitment to future reduction of protection, or without correct incentives for productivity gains, quality and innovation, are potentially welfare-reducing, and do not lead to economic growth. The explanation is that the costs of such policy (not only the static costs related to higher consumer price, but also potential dynamic costs related to production and technology) can easily be higher than the benefits, if proper incentives are not in place, or if protection is too high. East Asian countries are usually taken as examples of successful industrialization strategies, as they combined elements of protection with export promotion (thus incentives to become competitive). On the other hand, Latin American countries are usually taken as an example of failed ISI. However, given the country heterogeneity both in Asia and Latina America, each case study can show a myriad of different and country-specific aspects that played a role in the development results, as for example the differences in types and quality of institutions. Thus, going beyond a collection of case studies and reaching a general conclusion is quite tricky.

The heterogeneity in development levels, innovation and technology adoption has implications for the distribution of production among nations, with the least competitive countries falling behind while the best ones are able to catch-up with the economies already in the development frontier. Rodrik (2015) found evidence of premature deindustrialization since the 1980s: for most developing countries maximum levels of industrialization, in terms of employment and output, were reached at lower income levels, in comparison to older experiences. The exceptions, still according to Rodrik, are Asian countries, thanks to a stronger comparative advantage in industrial goods.

Thus, while the fear of deindustrialization, as noticed by Qian, Araújo and Nucifora (2018) may provide an excuse for protectionist policies, the scope for gains from protecting manufacturing is eroding, as acknowledged by Rodrik (2015). It is then necessary to know how to increase productivity and value-added within the domestic economy, in a world with faster technological progress and where traditional sources of comparative advantage such as labour costs, are losing importance. A potential answer is to look at the quality of institutions in general, and the business environment in particular. As cited by Qian, Araújo and Nucifora (2018), Easterly and Levine (2001) and Caselli (2016) show, based on cross-country comparisons, that differences in per capita income are a consequence of differences in total factor productivity. However, to know what causes these differences in productivity one needs to look at different layers of factors. Among these, the literature points to the quality of institutions as the single most important factor explaining productivity and growth (Torvik, 2016).

Given the difficulty in reaching a consensus based either on the multitude of theoretical results from the trade literature, and also on the diversity of empirical results, the literature on industrial policy of the last 20 years is focusing on the description of best practices – how to better design industrial policies – improving the coordination between policymakers and industry. The debate based on the use of protection and subsidies, between horizontal (basically, improving the business environment) versus vertical (sectoral, more protectionist) industrial policies is left behind, inconclusive. Thus, the theoretical discussion permeates not only the trade and growth literature, but also the literatures related to industrial policies, competition, industrial organization, and institutions. The potential answers are also scattered among these literature branches.

The Brazilian Automotive Sector

Vehicle assembling in Brazil started with Ford in 1919, followed by General Motors in 1925. After 1956, the Brazilian Government promoted an import-substitution strategy for the automotive sector, among other sectors. The restrictions on imports ceased, temporarily, only in the 90's. The policy achieved its initial targets, as Brazil started to produce thousands of vehicles with high local content, reaching economies of scale and developing important economic linkages (Shapiro, 1989). The economies of scale were viable thanks to the initial protection, to the market size, to the subsidies that reduced capital costs, and to the credible threat made by the Government to put a time limit to the governmental support (Shapiro, 1989). But, apart from a brief period in the 90's, protection continued, and the competitiveness of the sector suffered, making it difficult to be part of global value chains.

Currently, the automotive industry in Brazil is the most protected both in terms of nominal and effective tariffs, among all industrial sectors in Brazil, continuing to be heavily oriented to the domestic market. There is very little connection with Global Value Chains and the productivity of tier 3 and 4 autopart producers is generally very low, although the multinational automakers and both domestic and foreign-based tier-1 autopart producers are arguably as productive (within their plants) as their counterpart foreign plants. There are a relatively high number of firms in the market, but at least for final assemblers, the degree of competition in the domestic market is still an open empirical question. The policy towards the sector also incentivises local demand, not technological upgrading and productivity gains.

The automotive sector in Brazil involves 29 assemblers (61 industrial units), around 500 auto parts companies and 5.100 dealers (although the value chain includes more than 200 thousand companies). These numbers include vehicles and agricultural and highway construction machinery. The production capacity is of 4.5 million vehicles per year. In 2017, the sector produced 2.3 million vehicles (down from 3.7 million vehicles in 2013). The sector employs directly and indirectly around 1.5 million people (150 thousand directly employed by the vehicle assemblers). Including the auto parts sector, it is responsible for near 5% of the Brazilian GDP (21% of the industrial GDP). Based on 2017 figures, the Brazilian automotive sector is the 8th largest world car producer and the fourth largest domestic market.

The assembling companies are almost all multinationals (with characteristics of an oligopoly), although the auto parts sector (with all types of market structures, depending on the specific autopart) has an important participation of domestic capital.

Thus, the strategic decisions of these multinational firms are at the core of the underlying market forces that, together with the industrial policy, designed the landscape for the automotive sector in Brazil.

In a sense, the selected case study is the archetypal industry of choice for middle-income developing countries wishing to move beyond simpler labour-intensive industries. We chose the Brazilian automotive sector also because it is the most important industrial sector in the country; it is facing a crucial question regarding its viability without government support; is an example with firm heterogeneity and therefore rich in terms of variable responses to protection; it is a sector that illustrates very well the importance of scale; is globally characterized by being increasingly dependent on global value chains and global production networks; it possess a long value chain, making it possible to analyse cumulative effects of protection on inputs; the industry was targeted by a well-defined protectionist policy between 2011 and 2017 (Inovar-Auto), making it ideal for a "before and after" analysis; there is plenty of data for the industry; the researcher has expertise in the policy under study; and the presence of multinationals together with domestic firms further enrich the analysis of theoretical arguments for and against protection, mainly related to technological transfers.

Brazil was an example of a Latin American country following an ISI strategy based on high levels of protection until 1988, when the Government started to reduce trade protection, culminating with the generalized trade liberalization of 1990-1993. Subsequently protection was increased again, although not to the same levels of the ISI era. Although some protected sectors had a disastrous outcome (the protection of the Brazilian personal computer sector, for example), the country managed to achieve impressive records in some industrial sectors, such as aeronautical and oil extraction. The best sector to illustrate the heterogeneity of results is the Brazilian Automotive sector. Part of the literature concludes that ISI based on trade protection and subsidies was decisive in the establishment of the automotive industry in the country and that this industry effectively reached good competitiveness levels (Di Maio, 2009; Shapiro, 1989). What is more debatable is at what costs this happened. Moreover, why does the industry still need high import tariffs and why is it not able to export more? In other words, why it is still infant, or, at least, treated as infant?

Since its conception, the Brazilian automotive sector has focused on the domestic market. However, this reliance has some drawbacks: it increases demand uncertainty and thus reduces potential investment; and it reduces competitive pressure for innovation and product upgrading. Protectionism was used as a tool to attract FDI in all Brazilian policies towards the sector. Moreover, for the 1950`s policy (import Substitution strategy responsible for the development of the automotive industry in Brazil) and the 1990`s policy (aimed to counteract the effects of a supposedly overvalued domestic currency besides attracting new FDI to the sector) the intention was also to avoid trade deficits. Meanwhile, the most recent policy - Inovar-Auto (2011-2017) – shared the motivation to protect domestic producers from losing market-share to imports but had no strong concern regarding the current account. Besides this, only Inovar-Auto included R&D and fuel efficiency targets. None of the three policies directly promoted exports.

Inovar-Auto increased the level of taxation on imported cars by 30 percentage points between 2012 and 2017. This was challenged, since 2014, at the WTO, and since December 2017 the Program no longer exist. This policy had two main objectives and, according to our analysis, targeted two different subsectors of the automotive industry: the carmakers and the autopart producers. Inovar-Auto`s declared goals were to develop the technological level of the industry and to attract FDI. Given that the car manufacturers in Brazil are all multinationals, the scope for improvements in technological level is higher in the autoparts sector, where there are a mix of multinationals and local players, with different degrees of technological development.

The literature has vast amounts of accounts of the sluggish manufacturing productivity of the Brazilian economy, after a period of growth right after the trade liberalization of the early 90s, in comparison to most of the biggest developing markets, with the developed countries, and also with other Latin American countries. Both labour productivity and total factor productivity in manufacturing appear to have had, on average, a very weak performance in the last 3 decades (in chapter 5 we provide more evidence on this, for that we cite, among others, Kalout et al (2017) and Cirera et al (2015).

The potential channels

Scrutinizing the literature, we can propose a list of the theoretical channels that may play a role in the transmission of effects from protection against foreign competition to economic development and growth. In this context, we are not discussing if a country should accept its static comparative advantages or try to push to dynamic comparative advantages in sectors with more positive externalities. Instead, we are discussing how trade barriers affect the prospects for having more thriving innovative and competitive firms. In order to thrive, firms need to be competitive. Thus, “international competitiveness” is our main dependant variable. A more competitive sector would grow faster and to a higher extent, and thus tend to generate more income, with or without externalities. In this sense, in this thesis we assume that trade barriers affect productivity both at firms and industry levels, and these productivity levels affect “long-term industrial competitiveness”. This last variable is in turn a necessary condition to achieve economic growth and development.

The process of identifying the channels required a vast literature review, as sometimes the same channel is presented differently within different branches of the literatures examined. As already mentioned, we identify three main set of analysis related to the effects that changes in the structure of protection can have on international competitiveness:

- Scale: including internal and external economies of scale; investment location decisions; local content and domestic supply base; implication of domestic market size for R&D;
- Competition: including domestic and foreign competition effects on firm`s efficiency and on innovation efforts; and resource allocation.
- Technology: “within-border” or “cross-border” nature of technological spillovers; and access to better inputs and foreign technology.

Adding to these, we also identified the effects of business environment and investment climate, on international competitiveness. Recalling that we start from the assumption that trade barriers impact total factor productivity, labour productivity, and then competitiveness, we believe this analysis is quite comprehensive and can contribute towards a useful taxonomy.

1.3 RESEARCH QUESTIONS

The following assumptions framed our research questions:

- Protection has costs and benefits. Too much or too little protection rises it costs and reduces benefits. The underlying variable that links protection to the cost-benefit results is a combination of the size of externalities generated, if they exist, and the ability and speed of protected domestic firms to catch-up with the technology frontier. This ability and speed, for instance, depends on the competitiveness the firm and industry can achieve, and also on the distance between them and the frontier. The competitiveness, for instance, depends, among other factors, on the access to technology, on the scale that can be achieved, on the business environment, on incentives and policies, and on structural conditions.

- The intermediate sector (in a broad sense) could also generate externalities (technological changes in intermediates) and also benefit from scale gains. However, as protecting intermediates (Local Content Requirements - LCRs) means, ceteris paribus, to reduce the competitiveness of final goods, there is then a trade-off between favouring intermediate or final goods.

- Generalized protection can make general production costly, thus generating the need for further protection, in a potentially vicious cycle.

- Since the prominence of imperfect competition models in the trade literature, starting in the 80s, it is accepted that trade patterns are driven by a combination of comparative advantages related to the availability of production factors (mainly capital and labour, both potentially quality-adjusted), the firm-level scale of production of manufacturing firms operating in a country, and also the external economies of scale generated by technological spillovers from R&D. The more recent literature suggests that value added is not in manufacturing anymore, but in more knowledge-intensive activities and services prior or after the manufacturing process itself: R&D and design are usually used as examples. Moreover, although the literature has been studying the effects of institutions for some decades, it only recently started to collect evidence of institutions being able to shape comparative advantages. Finally, new economic activities are growing on the basis of network effects – the economies of scale from the demand side, and entirely new sectors have been created from start-ups and innovations that need the best IT infrastructure and a proper business environment to thrive. Putting all these insights together led us to the conclusion that from now on trade patterns and competitiveness will be driven by a combination of differences in competitiveness driven by differences in business environment, external economies of scale that includes network effects, and internal scale in value-added activities such as R&D.

As widely accepted by the trade literature since the 80s, assuming the existence of economies of scale, either internal or external to the firms, the increase of scale of production is an important step to improve a country`s comparative advantages and competitiveness[5]. Furthermore, endogenous growth models explain how innovation and adoption of technologies are the main drivers of productivity and economic growth, while the new economic geography states the role of increasing returns of scale in concentration of location. Therefore, the question is how to promote efficiency, scale, innovation and adoption of technologies, and attract the location of value-added activities? There are two crucial elements in this debate: a) what would promote scale, technology gains, and competitiveness and; b) the decisions for location of production and other value-added activities.

And what are the other aspects that could also enhance comparative advantages and competitiveness directly, or could promote scale or attract location decisions, and then

[5] External economies of scale can promote knowledge spillovers and other positive externalities that can make a country more competitive in some industries, and thus potentially creating comparative advantages that did not exist there before. The more recent acknowledgement that internal economies of scale do explain intra-industry trade and can drive location decisions is also considered another potential element in building comparative advantages, as the underlying productivity gains would make production cheaper.

indirectly promote a country competitiveness and welfare? The literature pinpoints institutions (or, alternatively, a subset of it defined as “business environment” or “investment climate”) as the main candidate, but recognize this concept is very ample and results can easily please whatever pre-conceived idea. We believe that a comparison among the effects of key business environment aspects, and the structure of protection (degree of tariffs escalation, levels of tariffs, access to technology through imported inputs), the impacts on domestic and foreign competition, and the degree of specialization, can bring insights on what else is important to increase comparative advantages and competitiveness and how trade can affect these elements.

Expressing the questions above in a more direct way we have the following research questions:

Why is the Brazilian Automotive sector not yet competitive after 60 years of protection?

1. **How is the sector evolving? How competitive is it?**

2. **What are the main channels linking trade policy and competitiveness? How do these channels interact? How does each channel operate within the Brazilian automotive industry?**

3. **What is the relative importance of the business environment, and of institutions in general, vis a vis the trade policy?**

4. **How can the pace of digital technological development affect the identified channels? Does it also alter the support for the selected theories?**

5. **What are the lessons from Inovar-Auto in terms of policy design?**

The last discussion we will have is to assess how the results from the case study could be generalized to answer the overall theoretical questions of the thesis. We aim to contribute to this debate through a combination of qualitative and quantitative data and methods.

Our research also analyses how the new digital economy and the emergence of the so-called industry 4.0 could alter the results from the channel analysis. The pace of technology is increasing and there is a debate on whether these new technologies will facilitate or hinder catch-up for developing countries. This discussion has profound implications for the results of any development strategy, including trade policies.

The underlying assumption is that protection can be welfare-enhancing or welfare-reducing, depending on a series of conditions given by the economic theory. Our primary goal answering the research questions is to provide empirical insights and evidence to the literature, contributing to the development of the theoretical knowledge in the field. The secondary objective will be to extract policy lessons. Proceeding this way, we aim to improve our understanding of the limitations of the infant-industry argument as a guide for industrial policies in general, using a case study of a specific industrial sector. We will focus on trade-related measures of industrial policies (how tariffs affect competition, access to foreign inputs, productivity and scale, for example). Moreover, the comments on policy design will be restricted to the case under study, without any theory testing or generalization. Furthermore, any discussion regarding policy implementation and about other instruments of industrial policies (technical assistance, government procurements, financing etc.) would be marginal.

1.4 OUTLINE OF THE THESIS AND OVERALL METHODOLOGY

The methodology is an inductive case study with qualitative and quantitative methods – thus, a mixed-methods approach, where we aim to provide insights from different economic literatures and using different data types and sources. Specifically, we analyse the Brazilian automotive sector, including automakers and autopart producers, providing enough context and data to have a more detailed understanding of the specific case. Although there is always the caveat of reaching conclusions that are maybe too case-specific, we are able to generalize some of the findings because: a) the industry under study is formed mainly by multinationals, that operate similarly around the world; b) we contextualize the analysis, helping to isolate factors that are specific to the Brazilian case, especially through our interviews and literature review of the automotive sector in Brazil.

Although De Loecker and Biesebroek (2018) successfully show that Industrial organization techniques to estimate market-power can disentangle it from other efficiency sources, they also accept that data constraints and ad hoc market classifications are still problematic. We believe detailed case studies can therefore provide meaningful insights. The advantages of this methodology will be explained in the methodological chapter.

Given the complexity in terms of interactions and country-specific factors involved, the research design to accomplish this task is a detailed case study. Moreover, to be able to use all information and data available, we use a mixed-methods approach, relying on qualitative (interviews) and on quantitative data (secondary data at the aggregated and at the firm-level). The qualitative data is central to the thesis, helping to make sense of the quantitative data and of the literature review on the case study. The quantitative data will help to build our evidenced-based narrative. This narrative will try to answer the research questions. In this sense, we will provide evidence from different sources of information, and this will be triangulated, to enhance the validity of the results: this is the purpose of using mixed-methods.

Chapter 2, the conceptual framework and literature review, will cover the theories that build the foundations of the arguments present in the debate on the effects of international trade on competitiveness, growth and welfare. This needs to include discussions about static and dynamic effects of trade and protection, as well as partial and general equilibrium considerations, and how assumptions of externalities and production factors` unemployment affect the results. We therefore aim to organize a full description of how the literature evolved and, also, pointing the shortfalls of incomplete arguments usually presented in the debate. While the theoretical framework will then provide our theoretical basis, the empirical literature review will focus on the empirical evidence regarding the identified channels.

The use of a case study with mixed-methods is explained on chapter 3, where we also provide details about each method.

Chapter 4 explain how the Brazilian automotive sector evolved and how it is organized, in the context of both a previous Import Substitution Industrialization process and the current position of being the most important industrial sector in Brazil in terms of GDP and also the one with the highest average tariff protection. The chapter provides further contextualization for our case study, gathering secondary data and insights on the new technologies that are affecting the sector worldwide, a brief description of the successful case of Embraer (highlighting its reliance on foreign inputs and its lower dependence on the domestic business environment), and a review of the industrial policies applied to the sector, with emphasis to Inovar-Auto. This last policy is analysed in enough detail to configure a before-and-after impact analysis.

Chapter 5 will bring the results from the interviews, with a partial analysis based on a thematic grouping. The methods used in chapter 5 are primary qualitative data collection and analysis, based on semi-structured interviews with a purposive sample. Chapter 6 contains the quantitative exercises and another partial analysis of the results. This applies a collection of secondary data and produces some primary quantitative data. It uses descriptive statistics of secondary data and analysis, including analysis of correlations, and time-series regressions using aggregated data. On chapter 7 we put the qualitative and the quantitative results together, analyse them with the inputs from the literature review and the theoretical framework, and produce our conclusion, with some policy recommendations.

The insights gathered in this study were plentiful, but a brief preview is useful at this stage, and can be summarised as follows: if a country is trapped in a low level equilibrium (no signs of dynamic learning or catching-up with more developed countries and industries) with overall low competitiveness, high import protection levels, underemployment and underinvestment, a trade liberalization process could be too costly in terms of unemployment in the short-term. This could block any meaningful trade reform, further increasing the welfare costs of a future adjustment. A potential alternative to allow the economy to enter in an economic growth path and eventually catch-up with the technology frontier is to improve the institutions and business environment. If this is sufficiently done there will be less political resistance to trade liberalization and the likely employment adjustments will tend to be smoother.

The Brazilian industry needs to be more specialized and export-oriented than it is, to gain scale of production and competitiveness. To this aim, the country would benefit from better access to foreign inputs and from lower overall levels of protection (to promote a better domestic allocation of resources and increase in average productivity). In which sectors to specialize is a market-driven decision, but one that could be influenced by a better business environment conducive to activities with high value-added, potential terms of trade gains, and more knowledge spillovers. The Brazilian automotive sector provided a clear picture of how a developing country can lose track of initially successful policies, if policymaking is biased towards rent-seeking interests.

CHAPTER 2 – CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

This thesis is intended to be eclectic both in terms of methods and in terms of literatures from where it draws insights and theoretical foundations. The theories we rely upon are mainly within the domain of international trade, but they include important contributions from industrial organization economic theories as well[6]. This theoretical framework provides logical constructs for the impacts of some of our variables of interest - trade structure, scale, competition, or institutions/business environment – on industrial competitiveness, productivity, and ultimately, economic growth.

Our exposition will build on the developments of the debate between import protection and trade liberalization. Section 1 will bring some important concepts needed for the thesis. In section 2 we expose the main theoretical foundations both for trade liberalization and for trade protection. We discuss how market failures can justify trade protection and discuss the theoretical base for infant industry arguments, among other justifications used for some protectionist policies. We also emphasize the message that different assumptions led to different results concerning the validity of trade protection as a growth and development strategy. Section 3 shows the evolution of industrial policies and trade theories based on the idea of relative comparative advantages. Section 4 briefly explain how insights from endogenous growth, industrial organization and institutional economics literatures contributed to the understanding of the theme, and partially changed the conclusions of the trade theories exposed in the previous section. Section 5 then explain the potential interactions among

[6] Including a very brief foundation of institutional economics to contextualize the importance of the investment climate/business environment for competitiveness.

comparative advantages, scale of production, business environment, competition, trade and growth, mapping the theoretical channels that could link our variables of interest. Section 6 discuss the empirical literatures on specific channels. These channels then constitute a taxonomy that summarizes our theoretical framework.

The main message from theory is that trade protection against imports can promote welfare if there are market failures such as externalities, but protection can be potentially damaging to overall scale of domestic production in the long term, given a potentially less competitive domestic value chain. Moreover, trade protection rises inefficiencies as well, and its costs and benefits would need to properly be assessed under a dynamic general equilibrium context. Therefore, a potential optimum structure of protection can be a function of many factors, including the market structure, the quality of institutions and business environment, and the interaction with other drivers of international competitiveness. The intermediary effects on the scale of production, on the level of competition (among domestic producers and also between domestic producers and imports), and on the innovation and technology absorption patterns are channels that can substantially change the overall result. Therefore, they need to be properly considered.

2.1 CONCEPTS

Initially it is important to clarify important concepts used in this thesis:

As in Krugman et al (2014), a country has **relative comparative advantage** in the production of a service or a good when this sector has a relatively[7] better labour productivity (the Ricardian model) or relative abundance of resources (Heckscher-Ohlin model). Thus, relative comparative advantages in a certain good explain a static efficiency in production of that good.

[7] Relative to other goods and services supplied by the country. Different from this, the concept of "absolute comparative advantages" would mean that the country has always better productivity, in absolute terms, in producing that good.

Productivity is a measure of the ratio of output (or, alternatively, value-added) per input, while **productivity change** is a measure of cost-savings in production, given the output-input ratio. It then measures the degree of efficiency in using inputs. There are measures of partial productivities, such as labour productivity (production, or value-added, per worker, for example) and measures of multifactor productivity, such as **Total Factor Productivity**[8] (this relates output to the technology used, eliminating all effects from labour and capital. As such, it can be estimated as a residual). The sources of productivity are many but can be organized following OECD (2001):

- economies of scale;
- technical change (innovation);
- technical efficiency within firms;
- technical efficiency arising from the flow of production factors towards the most efficient firms or sectors[9];
- learning-by-doing; and
- capacity utilization.

Another important source of productivity, not explicitly mentioned by the OECD manual, is the social infrastructure and business environment in general[10].

International competitiveness is the resulting combination of firm-level competitiveness[11], exchange rate, export costs (including transport), and business environment. In this sense, it can express the capacity to export, being able to compete in price and quality with foreign competitors in external markets. This definition takes

[8] As noted by Qian, Araújo and Nucifora (2018), labour productivity and TFP are highly correlated, but can become more different if labour productivity is a result of capital accumulation, instead of a result of the TFP. The authors also remember that to calculate TFP as a residual it is necessary that prices are reflecting marginal costs and marginal factor productivity.

[9] Going into more details, Qian, Araújo and Nucifora (2018) explains that sources of productivity at the aggregate level may be: (i) structural change (“between-sector”) caused by productive resources moving to sectors with higher productivity, thus increasing the market share of these sectors (“between-static”) or by an increase in the market-share of the sector with higher productivity growth (“between-dynamic”); (ii) sector-level (“between-firm”), when firms with higher productivity (levels or growth) gain market-share, while firms with lower productivity (levels or growth) lose market-share, within the sector. It includes the cases of entry and exit, when firms with higher productivity enter the market and firms with lower productivity exit the market.

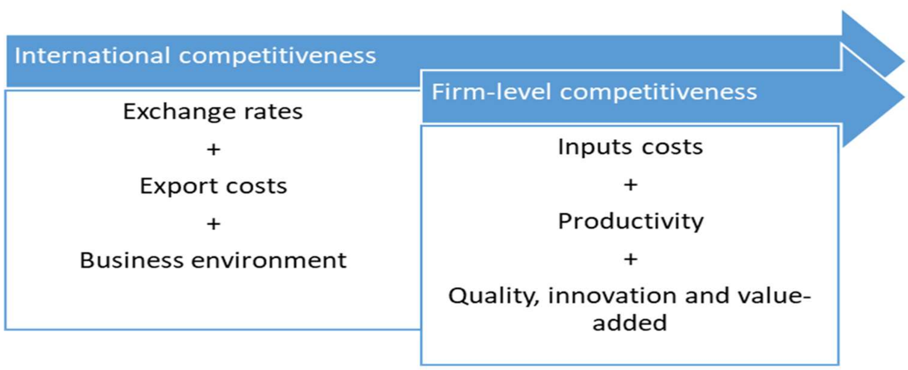
[10] This source of positive externality, and thus productivity, was mentioned as early as in Frankel (1962).

[11] Firm-level competitiveness is a narrower concept: the result of production costs (inputs and production factors), productivity, and quality/innovation/value-added combinations of the firm.

into consideration the relative competitiveness of other countries/firms and includes the effects of costs of production and quality. It is therefore more complete than simpler cost-competitiveness measures, such as, for example, the **Unit Labour Costs**[12]. It also differs from measures of **revealed comparative advantages**, such as the revealed comparative advantage in exports (Balassa Index), that measures the relative importance of the exports of a good in comparison to the overall exports of the country, and compare this ratio to the relative importance of world exports of that good in comparison to the overall world exports. In other words, it measures a relative concentration of a country in exporting a specific good[13].

The following **figure 1** illustrates these concepts.

Figure 1 – The concept of competitiveness



Of course, the factors that affect international competitiveness also will affect the competitiveness of the firm. In this sense, the factors in the two boxes are additive.

Internal economies of scale are gains in terms of productive efficiency (reduction of average costs) brought by increases in scale of production. As sources of economies of scale, we would have:

[12] This is a measure of how much in wages it is necessary to pay for a given output of production.

[13] Algebraically the Balassa index could be represented by:

$$\frac{\left(\frac{Exports\ of\ good\ i from\ country\ "j"}{Total\ exports\ of\ country\ "j"}\right)}{\left(\frac{Total\ world\ exports\ of\ good\ "i"}{Total\ world\ exports}\right)}$$

i) decreasing marginal costs[14];
ii) spreading fixed costs over as larger level of output.

Learning can be viewed as a dynamic effect of economies of scale, while the reduction of average costs would be a static effect. The reduction of average costs is then a static effect of internal economies of scale. If we also consider that increasing scale can increase learning by doing, we arrive at **a dynamic effect of internal economies of scale**[15].

A slightly different concept is **Return to Scale**. It focuses only on the technology of the production function of the firm, and is a potential source of economies of scale: when we have **increasing returns to scale**, characterized by an output that increases more than proportionately with the addition of inputs, the market structure needs to be one of imperfect competition. On the other hand, **constant returns of scale** refer to the case where any given proportionate increase in all inputs causes output to rise by the same proportion. Under this condition it is possible to have perfect or imperfect competition, because we could, for example, have constant returns to scale together with internal economies of scale. **Decreasing returns to scale** is when added inputs increase output less than proportionately. It is also possible to have perfect or imperfect competition in this case.

When we have internal economies of scale, the economic theory suggests that there will be no perfect competition in that market, as the firm will exploit its economies of scale and eventually will abandon a perfect competition market structure. On the other hand, we can have external economies of scale (within the industry or region) and perfect competition at firm-level.

Internal economies of scale are thus the gains generated and appropriated by the firm. More formally, average costs go down when firm-level output increases. On the other hand, **external economies of scale** are the gains that can be appropriated by firms that did not generate them: average costs go down when the industry or the

[14] This could be generated by the specialization that would follow a production expansion.
[15] If the learning "leaks" to other firms, we will have "external dynamic economies of scale".

regional output increases. The gains generated by aggregated production are a type of **externality**.

Externalities are benefits or costs that goes beyond the benefits and costs appropriated or supported by the firm[16]. Therefore, when are related to production, externalities are also named **external economies of scale:** the efficiency of a firm as a function of the output of the industry (Krugman, 1995), or even a function of the output of the economy or other firm. These, can be of the following types/sources:

a) Marshalian economies of scale (or, alternatively, Marshallian external economies) – external economies of scale related to geographical location, also known as economies of agglomeration. According to the literature, this type of external economies of scale consists of three main sources: availability of specialized inputs/suppliers/infrastructure/buyers; labour market pooling; and technological spillovers, with all these as a function of the size of the industry located in a specific region or cluster;
b) R&D and knowledge spillovers not necessarily related to spatial location;
c) Learning-by-doing with spillovers – a process where workers learn how to better produce the good thanks to practice (thus not necessarily linked to the scale of production, but to the time producing something and using machinery or applying techniques). This would be a source of internal economy of scale (in this case also refered as "dynamic increasing returns", but it can be assumed that the knowledge gained outflows to other firms as well, thus becoming a source of external economy of scale.

Most Marshallian external economies are also considered as **static externalities**, as they can increase productivity levels but do not make it grow indefinitely[17]. Conversely, Knowledge spillovers, including the ones resulting from dynamic learning-by-doing, are a source of dynamic externalities, and can, under certain conditions, promote indefinite growth. Thus, we can define **static external economies** as the situation when social benefits are higher than what is suggested by market prices. **Dynamic**

[16] It is noteworthy that externalities are considered market failures, meaning that with any type of externality the market forces will not led to economic efficiency in terms of resources allocation.

[17] Marshallian external economies of scale can promote knowledge spillovers – an externality, by the simple fact that firms are close together, what facilitates the share of know-how, even in a single point in time, but potentially as a function of the size of the agglomeration (the number and size of firms).

external economies, on the other hand, happens when the flow of social return of an investment is higher than the costs reflected by market prices.

In international trade, models assuming **imperfect competition** (and thus internal economies of scale) could provide a rationale for protection beyond that derived from external economies of scale. As stated by Junius (1997), external economies of scale provide a path dependence mechanism that makes any initial cost-advantage a reason for further investments, in a **circular causation** (Myrdal, 1957), or with **forward and backward production linkages** (Hirschman, 1958). As also noted by Junius, this is another way to express the concept of dynamic comparative advantages, and also the existence of multiple equilibria, where the winning region could have been anyone, but will be the one that first attract the initial investments. In growth theories, **endogenous growth** explains growth by externalities.

As in Harrison and Rodriguez-Clare (2009), a **latent or dynamic comparative advantage** would be a potential comparative advantage resulting from the exploitation of the available externalities (static and dynamic), discounted by the opportunity costs involved.

The last concept, the **effective rate of protection,** is the protection of final goods taking into consideration the protection of intermediate goods used in the production of that final good and the share of value-added in the production of the final good. Ceteris paribus, when you increase the protection of intermediate goods you decrease the protection of final goods, and the lower is the share of value-added, the higher will be effective rate of protection for any set of tariffs[18]. To fully protect against foreign competition all economic sectors in an economy, a policymaker would need to set all import prices above the domestic prices, through the imposition of a tariff (or another equivalent policy).Considering the entire value chain is produced (and then protected) domestically, this means that the nominal protection for final goods would need to be even higher.

[18] Provided the tariffs on inputs are lower than that on the final product.

2.2 Theoretical rationale for trade protection and for trade liberalization

Importance of assumptions

In a broader debate (impact on growth), Dani Rodrik reframe the idea that, when we consider dynamic (latent) comparative advantages, instead of only static ones, we could arrive at either net positive or at net negative effects of trade protection: “There is no determinate theoretical link between trade protection and growth once real-world phenomena such as learning, technological change, and market imperfections (here captured by a learning-by-doing externality) are taken into account” (Rodriguez and Rodrik, 2000, page 272).

The discussion as to whether trade liberalization promotes economic growth or industrial competitiveness, or not, is not only context-dependent (thus an empirical question), but also assumption-dependent, if are looking at theoretical models. A vast myriad of factors can alter the theoretical base for trade protection or liberalization. There is, therefore, situations and assumptions where trade protection is economically sound from a theoretical point of view, grounded on microeconomic foundations, as there are cases and assumptions where trade liberalization is the most efficient policy. We can then list the following factors that can affect the result:

a. Industrial organization assumptions about the market structure: perfect competition, monopolistic competition, oligopoly, or monopoly;
b. The existence and type of market failures other than non-perfect competition, such as unemployment; externalities etc;
c. Differences in perspectives: partial or general equilibrium[19]; and static or dynamic analysis[20] .

[19] While a partial equilibrium will analyse only the effects on a chosen sector, a general equilibrium framework would include the effects and the feedback effects on and from other industries and other countries, as well between intermediate goods` suppliers and final goods` producers.
[20] Static analysis would focus in efficiency gains in a specific point of time, while a dynamic analysis would take into consideration a temporal path and results in the future.

The baseline case

In an Arrow-Debreu equilibrium, without market failures, free trade is Pareto-efficient. As explained by Buffie (2001), within this case free trade would be optimal because it would equate consumers` marginal rate of substitution (MRS) and producers' marginal rate of transformation (MRT) to the relative world market prices of goods[21]. This would then be an efficient outcome. Therefore, under perfect competition and information, and no market distortions, protection against foreign competition decreases welfare. Moreover, within this framework, a country should specialize in producing what it has relative comparative advantages in. Proceeding this way this economy will make the most efficient use of its resources and will be able to buy more of what it does not produce. A tariff, for instance, would generate a dead weight loss of surplus given the fact that the domestic producers that don't have enough efficiency to survive under free trade now are in the market, producing at higher costs (thus using other resources from the economy). This inefficient domestic production means a higher cost to the economy in terms of opportunity costs of production factors and resources.

The social costs of a tariff protection could mainly come from:

1) Consumption distortions: net loss of consumer surplus, given the higher prices paid domestically (it is "net" because the loss of consumer surplus is deducted from the resources that are not spent anymore on the imported good and now will be spent on other goods, with lower utility. This difference in utilities is the basis for the deadweight loss of the consumer surplus);
2) Production distortions: extra costs of producing the protected good, instead of importing it cheaper and producing something else domestically (with better efficiency).

[21] Under those assumptions, every opportunity cost would be reflected by market prices, and private marginal costs would then be expressed as the sum of all opportunity costs of the factors used.

Departing from the baseline: imperfect competition, unemployment, and externalities

Policy intervention could be welfare-improving if the perfect competition and no market failures assumption is not holding. And this is the real-world case. To improve welfare under these cases the literature suggests that the cause of the specific market failure should be tackled directly, meaning that tariffs would only be recommended if trade is the cause of market failure (Buffie, 2001). Otherwise we would be using second-best policies instead of first-best ones.

Let`s start to add market failures. Supposing a market structure of imperfect competition, where it is possible to have internal economies of scale, protection could promote scale gains in the domestic industry and therefore reduce marginal costs of production[22]. However, there are two counterarguments against the claim that the reduction of marginal costs generated by the increase in internal scale at firm level would potentially counterbalance the domestic consumption surplus losses, cited before. The first counterargument is (a) if there were internal economies of scale, the domestic producer would have increased its production to reap the benefits, without the need for the society to incur in the costs of protection; (b) as we shall see later in this thesis, widespread domestic protection can also hinder scale gains, as it could bias the economy towards diversification and then hinder specialization. Therefore, promoting an inefficient allocation of production resources; c) protection for inputs could eventually negatively affect the competitiveness and scale of production of final goods.

There is also the possibility that production factors are unemployed, and their opportunity costs may not be reflected in the market prices. This could also happen because of other market distortions. In this case, the social value of production factors could be smaller than the private marginal costs, and, therefore, protection would imply less opportunity costs. In other words, protection would allow the use of unemployed

[22] It is important to note that, although it is an industry characterized by internal economies of scale, there could be market characteristics such as a love for variety that makes the existence of different producers viable. This is encompassed by the monopolistic competition models with differentiated goods. Moreover, institutional constraints such as competition and antitrust regulations, or even weak societal laws, could induce a suboptimal domestic production pattern.

resources that otherwise would remain unemployed, thus potentially enhancing welfare[23]. These opportunity costs are also known in the literature as efficiency prices, or shadow prices. The message is that without perfect competition and information, or in the presence of some market distortion, market prices do not reflect the economic value of resources. Therefore, under market failures, the private marginal cost would not properly account for the social opportunity costs.

Either under an imperfect competition or under a perfect competition framework, another different outcome would appear if we assume the existence of positive externalities in production. This would also give another rationale for protection, as an eventual new or expanded domestic activity that generates externalities could potentially compensate the costs of protection[24]. The focus would then be on how to assess the potential size of these externalities, to verify if they in fact compensate for the costs of protection. Buffie (2001) demonstrates that with external economies of scale, for example, a small tariff can be welfare-improving, as the benefits of the increased domestic production could be bigger than the costs in terms of consumption distortions. However, there is still a discussion on if a production subsidy would have the same benefit, with less distortions, provided, for example, that the taxation needed to raise funds for the subsidy is not too distortive.

One argument derived from the existence of potential externalities is the infant industry argument: protection would allow learning by doing because there would be the accumulation of time for the workers to improve their abilities within the new industry. This learning by doing is derived from time, not necessarily from the scale (size) of the industry, as showed in the earlier paragraphs. However, if we assume that this learning by doing is only internal to the firm – in other words, the learning does not leak to the rest of the industry or economy, we would incur in the same criticisms and

[23] Buffie (2001) provide a general equilibrium model that accounts for different scenarios and assumptions to calculate the size of protection that could improve welfare in the case of unemployment and underinvestment. The result points to a steep tariff escalation, to allow access to imported inputs, but keeping nominal tariffs on final goods at a relatively low level: 7 to 10% in the case were there is unemployment causing a wage differential of around 50% between the manufacture sector and other sectors in the economy. The main reason for the tariffs to be low, as pointed by the author, is that demand for imports is very elastic, and then any increase in the protection level can increase the consequent distortions more than proportionately.

[24] These externalities could be in the form of technological spillovers; specialized input availability; labour pooling and others.

counterarguments explained for the case of internal economies of scale. For we to overcome those criticisms it is necessary to assume that the learning derived from the time the industry was protected leaks, thus being a positive production externality. This learning by doing with spillovers is usually assumed to be concentrated in industries with higher technological content. Ultimately, the economy could gain enough competitiveness and then relative comparative advantage in a sector with more growth potential – this is what is referred in the literature as dynamic comparative advantages or defying comparative advantages.

Then, if we consider a dynamic framework, we arrive at arguments that advocate the use of protection to modify comparative advantages, as already exemplified by the infant industry argument. However, there still are practical difficulties, such as how to assess and measure externalities, and political difficulties, such as possible retaliations from other countries, and the risk of rent-seeking behaviour and capture by lobbies seeking further protection.

Putting together assumptions and results

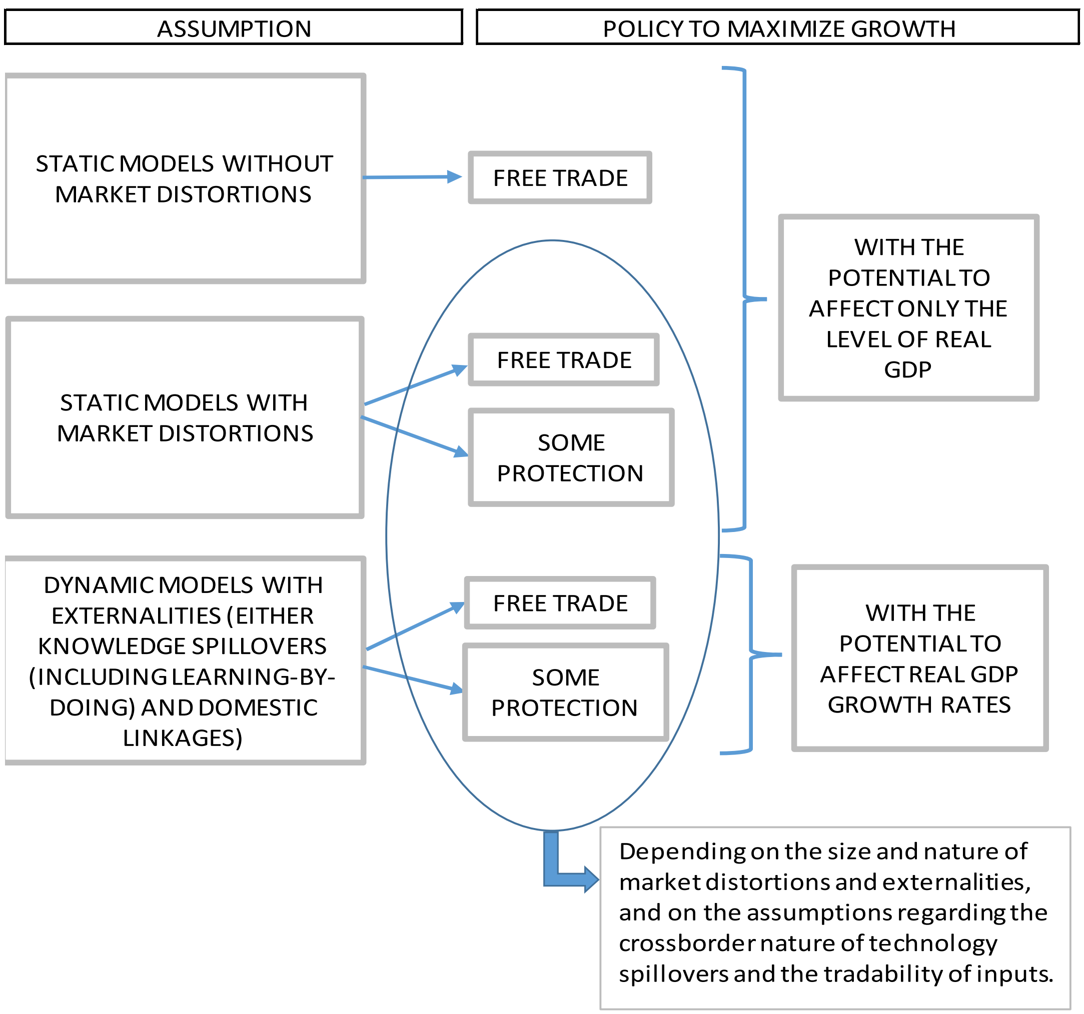
Taking together Rodriguez and Rodrik (2001), Trindade (2005), and Matsuyama (1992) we can summarize what economic theory has to say about trade protection and economic growth:

a) Under static models and no market distortion any trade protection would produce a smaller real GDP level;
b) Assuming the existence of market failures, even under static models trade protection could, sometimes, generate a higher real GDP level;
c) Under the assumption of endogenous growth generated by technological spillovers (externalities) the result is ambiguous: trade protection would reduce real world GDP growth (as it would reduce the market size for some innovations), but could also prevent a fall in GDP for some countries that would be left behind in the case of a trade liberalization (if technology does not sufficiently spillover across international borders). If the trade protection promotes the development of a sector able to generate enough positive externalities in the future, endogenous growth models can show a positive effect on real GDP growth rates. If trade protection makes more difficult for the

domestic economy to produce or adopt technology, protection is obviously damaging growth prospects;

d) Assuming coordination failures and externalities in the form of forward and backward linkages, trade protection would also be ambiguous: i) a further assumption that inputs are non-tradable would support the case for trade protection to promote domestic production of intermediate goods and then further domestic linkages, what arguably would promote the competitiveness of several industrial sectors; ii) assuming input-tradability, trade protection could be unnecessary (or even damaging) – as the economy could make better use of key imported inputs – and then the domestic production would follow a path where it has more competitiveness.

Figure 2 – How assumptions affect the desirability of free trade



The theoretical literature then seems to point to a bottom line were the result will depend on how trade protection affects domestic externalities – it could in theory either promote it or hinder it. A Myriad of theoretical models thus seek to gain insights into those ambiguities, trying to explain specific mechanisms, or channels, from trade policy to economic growth.

Static externalities and distortions

Any activity that is induced by trade protection and that provides a social benefit superior to the private benefits, and those social benefits are constant over time could be characterized as a static externality. If trade protection is needed for this, it would be warranted – provided these benefits outweigh the social costs of protection, of course. For example, the availability of a pool of specialized labour attracted by the process of agglomeration in an industrial cluster can be classified as a permanent externality.

Unemployment, for example, could be a static or a dynamic distortion. In static terms, a tariff could be welfare-improving if the avoided unemployment costs are higher than the consumption and production distortions brought by the tariff. However, this is not always the case, as the distortions can be higher, and, moreover, protection could be refraining a dynamic resource reallocation of labour from less to more competitive industries. This would then be a source of lower productivity and lower growth. Thus, the case for trade protection to alleviate unemployment would be more likely to make sense when relatively small tariffs are sufficient to maintain relatively large employment levels, and this is more likely to happen in labour-intensive industries. This conclusion helps to explain the success of sectors such textiles in lobbying to maintain relatively high protection levels in many developing countries, including Brazil.

Nonetheless, the case for tariffs is very undermined by the fact that a production subsidy would not generate the consumption distortion of the tariffs, and, besides potentially incurring in a distortionary taxation and higher administrative costs, could potentially be a superior policy. Moreover, any employment kept at the expenses of higher tariffs or subsidies could mean that an initial static inefficient resource allocation could eventually turn into a dynamic distortion, as the economy would tend to stick to labour-intensive sectors that could be less dynamic in the future.

Dynamic externalities related to mature industries

As an example of dynamic externalities that could be promoted by supporting mature industries, we have externalities generated by innovation and technology spillovers, resulting from higher production scale. This can thus be an argument for the promotion of "national champions", or simply to the growth of already mature industries.

We define National champions as large companies incentivized by Governments to became even larger and thus reap economies of scale benefits[25]. The theoretical case for the promotion of "national champions" through trade protection share many of the arguments used for the infant industry and other import-substitution strategies. The choice of policy to support those industries may vary, though, as national champions can be fostered by the promotion of mergers, for example. The rationale is usually the same: to foster innovation and reduce costs through economies of scale and scope. The main assumptions are that bigger firms can deliver more than proportionate increases in innovation[26] and other social gains (thus, there are either internal and external economies of scale - externalities), and that some internal economies of scale could not be achieved by market forces alone (implicitly assuming problems in the institutional setting). However, on top of all caveats and theoretical weakness applied to the infant industry arguments, the promotion of national champions also bears the question of how important is to have a "national" firm, vis a vis a foreign owned with the same investments in the domestic market[27]. Furthermore, firms that are too big can be shown to have less incentive to innovate (see chapter 3), and mergers can

[25] This definition is related to the example of Korean chaebols.

[26] Theoretical arguments behind this assumption: being bigger would imply being less prone to failure and thus less risky, what would then encourage suppliers to work together within R&D, and being bigger would allow access to higher amounts of funds, necessary to finance some R&D.

[27] The benefits of such a firm being "national" rests on a set of possibilities similar to that of FDI: depending on the type and characteristics of the firm and the market, being domestically owned or being foreign owned could have similar or different implications.

increase the degree of oligopolization, with effects on prices and output. (Falck, Gollier and Woessmann, 2011; and Spector, Chapsal and Eymard, 2009).

Another potential argument for protection of mature industries would be imperfect information: if the risks of investing in a firm or sector is high because of a lack of information or knowledge, but this investment could potentially generate enough externalities, protection may be used to incentivize the investment. However, as pointed by Baldwin (1969), tariffs cannot provide the information needed by those investors, and thus may be ineffective.

Dynamic externalities related to infant industries and industrialization efforts in general

There are many different arguments for infant industry, in the literature. Following the work of Grubel (1966), Baldwin (1969), and Kemp (1960) we will present the evolution of such arguments, and the eventual weakness.

Classical arguments (based on the assumption of perfect competition):
(i)"Broad classical argument": as explained by Gruebel (1966), it calls for overall industrialization, arguing that the private rate of return of the investments in industry is lower than the social benefits in terms of a society better prepared to engage in such economic activities.
(ii) "Narrow classical argument" – learning-by-doing: Time devoted to an industry, domestically, allow for a reduction in its average production costs.

In both cases, under perfect competition, protection would be potentially justified only if these activities do generate enough externalities (these need to be available to other firms and be sufficiently large to pay for all social protection costs), otherwise the private decisions under free trade would reach the potential outcome without the need of distorting tariffs or costly subsidies. (Gruebel, 1966; Kemp, 1960). As a result, under these assumptions, the valid argument for infant industry protection is that of externalities arising from learning-by-doing (Gruebel, 1966). Thus, the most accepted of the traditional infant industry arguments is that learn by doing will spillover onto other firms or sectors, therefore generating a positive production externality that will allow the average production costs to be reduced to a point eventually equal (or even bellow) the international prices. At this point protection would be unnecessary. However, as noted by Baldwin (1969), there are counterarguments: even if firms are not able to fully protect the learning generated by their own employees (what the author believes they can do through contractual arrangements, for example), it would be expected that workers would finance their training – if this was indeed valuable to other firms – and sell their knowledge. Therefore, market forces would be able to foster learning by doing spillovers without the need of tariffs.

"Modern" arguments (based on the assumption of imperfect competition and uncertainty):

(i) Hirschman linkages and the interdependence of investments: The interdependence argument is based on a potential need for coordinated investments in order to allow for a higher internal economy of scale, in a process that can then generate externalities to the whole industry. Similarly, Hirschman points that with trade protection is possible to direct investments to a sector with more potential linkages and thus more potential externalities in this sense (Grubel, 1960).

(ii) Any distortion that reduces investment in industries with more growth potential. As an example, wages in manufacturing that are higher than their opportunity costs, or new activities that involve a higher risk for the first entrants (without a proportionate potential reward).

(iii) Protection against developed countries` imports, while allowing trade and subsequent internal scale gains among developing countries, what then would generate domestic external economies of scale.

For most of the 20th century, the most used theoretical framework for industrial policy in developing countries was the Infant Industry Argument[28]. The traditional Infant Industry Argument (as defended by John Stuart Mill, following the ideas of Hamilton and List) is based on a temporary protection allowing a learning process and the accumulation of skills and know how that could then drive down production costs, making the home industry able to compete with foreign countries that had the

[28] The infant industry argument was pioneered by Friedrich List ("The National System of Political Economy", 1841) and by John Stuart Mill ("Principles of Political Economy", 1848). Later on, economies of scale (Graham, 1923) and externalities (Arrow, 1962) were studied as potential reasons for protection.

advantages of starting earlier. As discussed by Baldwin (1969), this learning can be internal to the firm or external to the firm. In the internal to the firm case, the social benefits would come in terms of more employment and income, but, as a later literature stress, it cannot provide a theoretically robust reason for protection, as someone can always assume that the private sector would be able to finance industries with potential internal economies of scale (Baldwin, 1969).

The main critics against the infant industry arguments can be summarized as follows:
1 – The capital markets would finance any viable investment, and thus the only scope for subsidies or trade protection would be when there are externalities, and these externalities need to be large enough to compensate for all social costs generated by protection or subsidies[29];
2 – The government lacks the necessary information to guide policy;
3 – There are potentially more efficient alternatives to foster the targeted sectors (such as subsidies, for example);
4 – Rent-seeking can turn the temporary protection into permanent ones, and also promote a level of protection unnecessarily high. Moreover, the belief in their lobby power and in a potentially permanent protection could make firms enjoy the protection without proper investments and learning.

Assuming the potential positive externalities are possible to estimate, and if the decision is to use a sectoral policy instead of a more horizontal ones, the decision about protecting/subsidizing or not the infant industry will need to be assessed by a comparison of the potential learning and externality generation and the costs of

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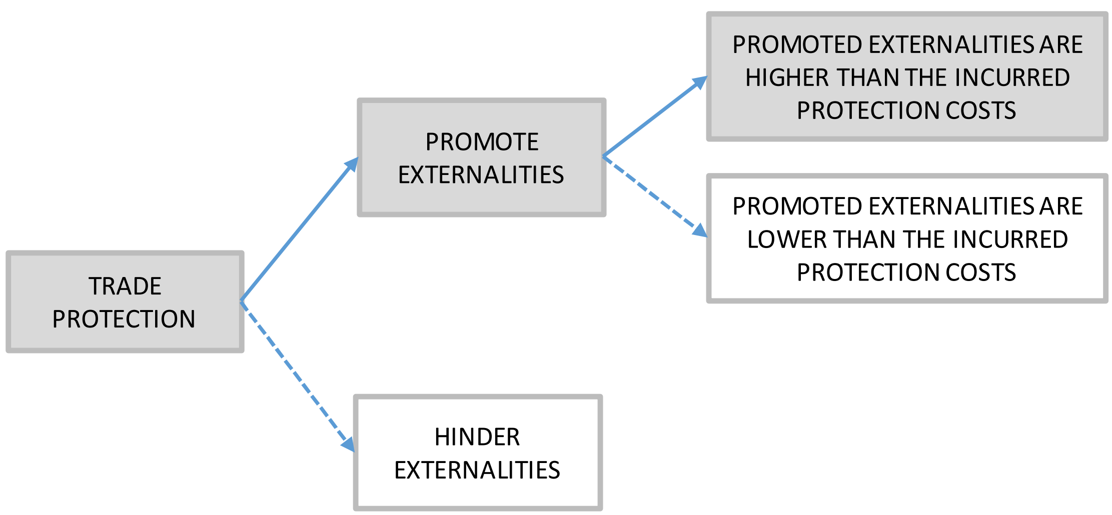
[29] Now brief comments on the choice of tariffs, quotas, and subsidies, as a deeper discussion on it is beyond this thesis. Buffie (2001) considers that quotas are not theoretically defensible, while Melitz (2005) argue for its superiority in some cases. If a lump sum tax is not possible, a government would have to use a distortionary tax to finance a subsidy. However, as explained by Buffie (2001), a "consumption tax on the importable good, smaller than the equivalent tariff, would suffice to pay for the subsidy". On the other hand, a system of taxation and subsidies have more administrative costs. Moreover, if the source of distortion is endogenous, such as the example found in Buffie (2001) of Unions raising the manufacturing wages as a strategical response to policy, the desirability of tariffs or subsidies would depend on other behavioural assumptions.

In other words, to develop industries that are too far from the viability level can be impracticable, as a necessary condition for the argument to hold is that the industry can be competitive in the future and thus protection is temporary.

supporting the sector, both brought at present value[30]. This is the so-called Mill-Bastable criteria, formalized in Melitz (2005). The question is a cost-benefit analysis, taking into consideration the present value of the benefits in terms of externalities generated (remembering that the benefits in terms of internal economies of scale should be privately financeable) and the costs of protection. The decision of protecting or not a sector is then an empirical one and will depend on the result of the Mill-Bastable test: if the protected industry generates enough externalities (specially learning externalities), if it is able to compete without protection after some time, and if the total social benefits of protection outweigh the total social costs.(Melitz, 2005).

Figure 3 – An expanded "Bastable-test".



Thus, to "pass" a Bastable-test as depicted in figure "4" above, an industry should display either enough externalities (Marshallians or not) or a latent comparative advantage (i.e. scope for rising externalities), and, with enough positive externalities there is theoretical basis even for permanent protection (Harrison and Rodriguez-Clare, 2010).

[30] In other words, to develop industries that are too far from the viability level can be impracticable, as a necessary condition for the argument to hold is that the industry can be competitive in the future and thus protection is temporary.

However, the literature suggests other aspects that need to be considered in order to assess the potential costs and benefits of an Infant Industry Argument strategy. One of particular importance for developing countries is the possibility of the Infant Industry tariff structure or subsidy inducing the use of a worse technology. This could happen by different channels, but a protection of inputs harming the final goods` production is perhaps the most common. The idea is similar to the debate regarding the use of Local Content Requirements[31]: if the final goods` producers have less access to imported inputs (potentially cheaper or with better quality) – either by regulatory imposition or by fact of import tariffs, domestic final goods` producers may show lower competitiveness, lower sales, and then lower scale, in a vicious circle[32].

As the infant industry argument is all about generating learning and externalities, a potential attachment to more traditional or less efficient technologies can abort all the development process. This idea is found in Saure (2007). However, this idea is in contrast with the arguments asking for a more diversified economy, found in different strands of the literature, such as, for example, Matsuyama (1992).

Saure (2007) and Milberg, Jiang and Gereffi (2014) suggests a modification of the infant-industry model to allow for the negative effects of using a more expensive and less advanced input when there is protection. The first author synthesizes his argument saying that “infant industry argument suffers a severe drawback when the sectors that exhibit learning externalities can be out-competed by a domestic traditional low-growth technology” (Saure, 2007, p. 115). The assumption that domestic producers can chose a lower technology is reasonable and the literature

[31] In fact, local content requirements would only prevent access to certain foreign inputs if there are mandatory deletion requirements. Otherwise the choose of inputs to reach the minimum threshold of local content is made by the firm.

[32] However, an important observation needs to be done: in the Brazilian automotive sector most first-tier suppliers are foreign multinational firms, with access to world-class technology. Thus, local content requirements would only negatively affect technology adoption if the requirements reach lower tiers in the supply chain or if they are set sufficiently high to prevent the use of inputs that were imported by the first-tier suppliers but cannot be domestically-produced at reasonable costs. Local Content Requirements would neither encourage new investments from these multinational suppliers, as their location decisions are very attached to the location decisions of automakers – in fact, high local content requirements could even have the opposite effect: if the requirements make automakers`s costs too high, they may decide not to locate their production at the domestic market and thus would be followed by the tier 1 suppliers.

admit that even technologically advanced goods can be manufactured using alternative low technologies (Lederman and Maloney, 2004).

Protection can negatively affect domestic scale because it can increase the costs of inputs, and then reduce competitiveness and exports. On the other hand, it can promote domestic production, if externalities compensate for the overall lower competitiveness. As Krugman (1995) explains, since Ethier (1979) it is mentioned that most trade within an industry is among differentiated intermediate goods, and thus there is probably much international external economies of scale on this ground. Therefore, tapping into a foreign-based supply of intermediate goods produced at high scale could be more efficient than relying on domestically produced low scale inputs.

Infant industry argument can be applicable in an industry dominated by multinationals as well: although these firms already have access to knowledge, the training and experience given to the domestic employees can be beneficial for the future competitiveness of domestic operations of that multinational and also for other sectors, if this knowledge leaks.

Imported X domestically-produced intermediate goods

Import Substitution Strategies relies on the State to lead the development process, and thus it can be said that this type of policy is inspired by Keynesian economics. Moreover, although it has usually an inward-looking perspective, in opposition to trade-liberalization approaches, it can be combined with export targets.

An array of theories and arguments provided the theoretical basis for Import-Substitution as a development theory. Among these arguments there are the infant industry argument; the theory of terms of trade deterioration for primary goods vis a vis industrial goods; horizontal complementarities (the existence of enough domestic sectors – intermediate and final goods, allowing the creation of other sectors, thanks to the linkages among these sectors); vertical complementarities (the existence of domestic inputs allowing the existence of final goods production and vice versa; and the "big push" argument (the promotion of virtuous growth cycles initiated by an uncoordinated or a coordinated private or state action)[33]. The goal of I.S. strategies could include: 1) reaching a "critical mass", when the emphasis was on having a broader industrial basis in order to allow the domestic production of other sectors – as forecasted by "big push" arguments and production linkages (Hirschman, 1957); 2) internal to the firm scale gains, to allow for cost reductions of "national champions" and to generate domestic market for suppliers; 3) external to the firm scale gains; and 4) to acquire experience and skills through time devoted to production, as argued by infant-industry arguments.

Thus, apart from the obvious case for export promotion and the coordination efforts, the overall theoretical and empirical question to be solved is the trade-off between specialization and diversification.

Inputs can be assumed to be tradables or non-tradables. Models that assume that inputs are non-tradable would tend to favour trade protection as a policy to foster domestic input production, hoping for the creation of a "critical mass" and then conditions for a dynamic scale growth. Thus, these models argue that trade liberalization for intermediate goods would damage the intermediate domestic sector and without enough domestically-produced inputs there would be lower domestic production complementarities (for some models the important are horizontal complementarities[34], while for others, vertical complementarities) and thus lower competitiveness for the final goods and lower economic growth for the country. Matsuyama (1992) is an example of models focusing on the importance of vertical complementarities (domestic input availability favouring final goods production and vice versa). These ideas can be seen as a generalization of Infant industry arguments, as they ask for the development of entire sections of manufacturing sectors, potentially including suppliers from other industries.

[33] "Big-push" strategies could also be initiated without the need of protection, using, for example, export promotion and policies that promote coordination or that supply the basic needed infrastructure.

[34] Basically, assuming that a developing country should tackle all its complementarities and bottleneck at once, would face the obvious caveat that under limited resource availability this is logically impracticable. The argument is then that some investment decisions are interdependent, and the development process would be faster if the sectors with higher domestic linkages are promoted, as suggested by Albert Hirschman.

Matsuyama (1992) argues that the low availability of domestically-produced specialized inputs would imply a higher use of labour-intensive technologies and then the country would be locked to a lower stage of development. In other words, the availability of input variety would allow a better choice of technology. It is assumed that these domestically-produced inputs gain competitiveness with scale, as the intermediate sector is assumed to be monopolistically-competitive. Moreover, as mentioned before, the assumption of non-tradability of inputs is crucial for the model. It is also worthwhile to reinforce that coordination issues are considered by the author as a type of externality, to justify the trade protection: the virtuous cycle of growing production in some sectors helping to grow the production of other sectors.

On the other hand, arguing for trade liberalization in inputs we have models that predict specialization within the domestic intermediate goods and also access to better technology from imported inputs. Trindade (2005), for example, argues that a trade liberalization in an intermediate sector characterized by increasing returns of scale, and tradable inputs, could induce specialization[35] within that intermediate sector (some inputs would gain scale while others would cease to exist domestically) and this would foster the competitiveness of final goods and would promote a gradual forward and backward linkages` growth. Assuming that the exporting sector can generate domestic positive externalities, the economy would enter a virtuous cycle of increased availability of domestically-produced intermediate goods, all with enough scale to be competitive. Complementing this argument, Saure (2007), for example, highlights the risk of protecting intermediate goods leading to the use of less advanced technologies and thus damaging the prospects of dynamic scale growth.

The underlying hypotheses is that access to imported inputs can bring lower costs, better quality and more variety (Ethier, 1979; Grossman and Helpman, 1991; Halpern, Koren and Szeidl, 2015). Specifically starting with Ethier (1979) is the focus on the concentration of large-scale worldwide production of intermediate goods, and the subsequent dominance of these goods in international trade. Those models, such as Halpern, Koren and Szeidl (2015) usually assume imperfect-substitution between

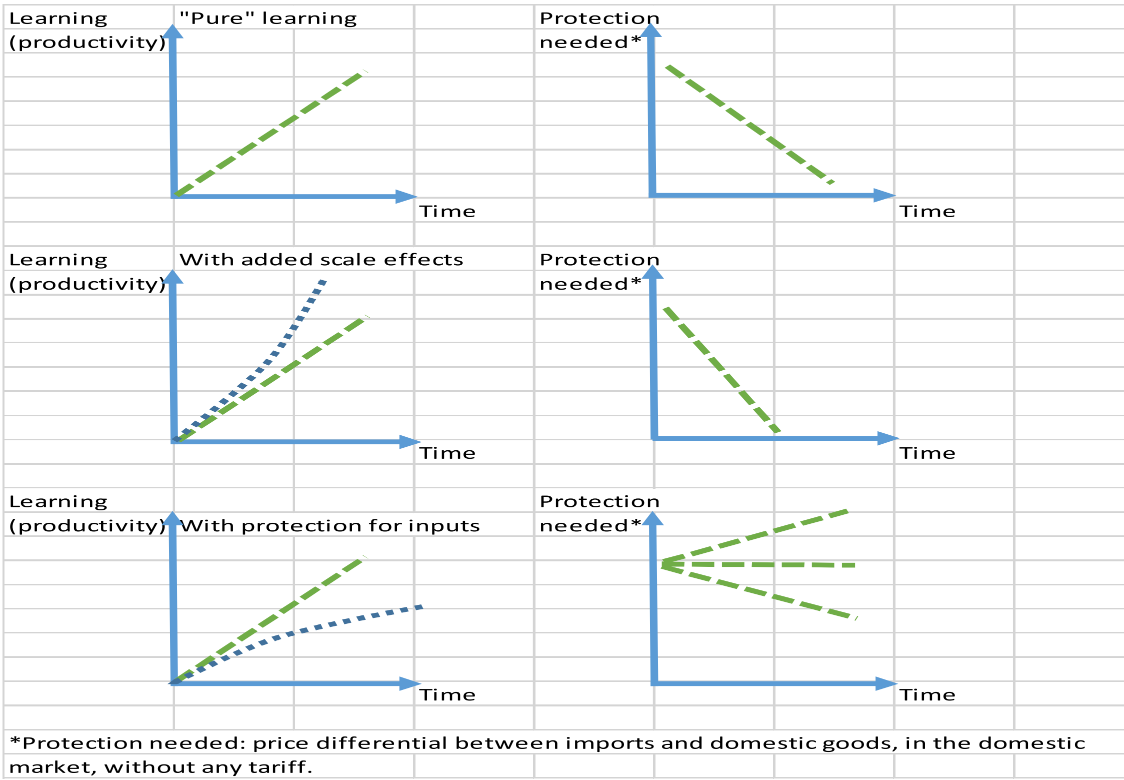
[35] In Trindade (2005) the specialization is driven by the assumption of increasing returns to scale in the intermediate goods, and a combination of higher competition between domestic firms and imports, and lower wages allowed by the trade liberalization.

foreign and domestic inputs, and thus the access to more variety of inputs – domestically and imported, is good for productivity. At the same time, a higher degree of imperfect-substitution means that there are some domestic inputs that would only be substituted by imported ones if the differences in cost-quality is big enough.

Ciccone and Matsuyama (1996) theorizes that the lack of enough specialized inputs forces firms to resort to production technologies that are more labour-intensive. This can be read as a defence of the domestic diversification: more variety of intermediate inputs domestically produced to be chosen from. However, the need for a variety of specialized intermediate inputs could also be fulfilled by imports – in fact, with greater variety. Thus, it follows the argument presented in Saure (2007), where protection against imported inputs forces firms to use less efficient technologies – a conclusion similar to Ciccone and Matsuyama (1996), but with opposite recommendations as it is favouring imports instead of domestic production of inputs. Saure (2007) and Milberg, Jiang and Gereffi (2014) suggests a modification of the infant-industry model to allow for the negative effects of using a more expensive and less advanced input when there is protection. The first author synthesizes his argument saying that "infant industry argument suffers a severe drawback when the sectors that exhibit learning externalities can be out-competed by a domestic traditional low-growth technology" (Saure, 2007, p. 115).

Figure 4 illustrates the idea behind Saure (2007), showing that learning potential reduces the protection needed over time, and scale gains add to this effect. When there is less access to imported inputs there is a dragging effect on the learning and productivity growth, with reflex on the protection needed. This range of outcomes in the final graph is not presented in the original Saure`s model, but we believe it is straightforward to assume that in the extreme case the protection needed could increase over time.

Figure 4 – protection needed as a function of learning, scale and access to inputs



The last graph shows that the level of protection needed for final goods could increase over time, if productivity is damaged by more protection on inputs, in a vicious cycle, if not enough scale is gained to counteract this effect. If there is enough domestic production scale gained, the protection needed could be flat or decreasing over time.

The counter-argument against protection in a world with externalities would primarily say that some structures of protection can do harm, not good, to potentially externality-generating industries: firstly because the level and duration of protection can easily be too high and then the costs of protection would be higher than the potential benefits arising from externalities; secondly because once potential externalities are properly identified, some structures of protection can negatively affect the competitiveness and catching up prospects of the targeted industry. As an example, we can think of the argument modelled in monopolistic competition models, where freer trade can allow for more specialization, scale and efficiency gains, and thus promote the externality-generator industry. The question is then where the industry would locate its value-added activities, including production plants and R&D centres, for example.

Fundamentally, policies promoting international competitiveness are conducive to the participation in global value chains, while protectionist policies tend to go in the opposite direction (Tijaja and Faisal, 2014; Saure, 2007; Halpern, Koren and Szeidl, 2015).

Global Value Chains can help firms and countries to achieve economies of scale through the specialization of production in intermediate goods and services to be sold globally or using intermediate goods and services produced abroad in these same GVCs.

Stone et al (2015) cite Grossman (1981) as a seminal model for analysing the effects of local content requirements. This model assumes that domestic input supplier has lower technology and is more expensive than the alternative foreign supplier. The result is that the producer of domestic input will enjoy initially higher demands for his products, but domestic companies that buy that input will face higher costs and thus lower production and demand for that inputs. The net result will depend on the elasticities involved: if the demand for the "protected" inputs increase more or less than the increase in the prices of these inputs[36].

Goldberg et al (2010), highlights that theoretical models, such as Ethier (1982), Romer (1990), and Grossman and Helpman (1991), for example, predict productivity gains arising from imported inputs.

While in the LCR argument, the production of final goods is negatively impacted by the rising costs (and maybe lower quality) of protected inputs, while in the Saure (2007) model, for example, the production of final goods is negatively impacted by the fact

[36] However, as also pointed by Grossman (1981), if the local content requirement favours a producer with market power the consequence is welfare loss, thanks to the enhanced ability of the producer in restrict production and increase prices.

that it now uses a less advanced technology. Overall, the final good can become worse and more expensive. At the end, the effect on the input sector would be the same: less demand.

Young (1928) for instance, argue that the lack of good inputs prompts to the relatively simple methods of production in downstream industries, thus generating lower demand, in a vicious cycle. This could then be an argument for protection if it is not possible to rely on foreign inputs.

Thus, economic theory seems to point to free trade as a superior policy to enhance welfare when there is: no market failures; or, even with knowledge externalities if this knowledge spillovers across borders. On the other hand, the theoretical literature basically points to the existence of market failures (unemployment, externalities etc) as the situations where some protection against imports could be welfare-enhancing. However, structures of protection that undermine the overall scale and competitiveness of other sectors can be counterproductive. Thus, it is not only a matter of identifying and assessing the existence of externalities and other market failures, but also of how to proper design an eventual structure of protection, if this is indeed needed. As market failures are the norm in the real world, the question is how to design the structure of protection to reduce distortions, minimize government failures, and promote, instead of damage, overall competitiveness.

2.3 The evolution of trade theories and industrial policies

As stated by Krugman et al (2014), the trade literature still reckons that international borders and distance have important effects on trade patterns and production location. The most important difference between what is accepted now and what was the mainstream in the international trade literature before the 1980s is that now internal economies of scale complement the relative comparative advantages[37] as

[37] The relative comparative advantage Ricardian model is based on the relative productivity of labour: a country would specialize and then export the goods in where it has relatively more labour productivity on it. On the other hand, the Heckșher-Ohlin model predicts a country would specialize and export the good that uses more intensively the resource or the production factor that is abundant in that country, given the available technologies (combinations of labour and capital).

explanations for international trade[38]. Arguably, scale would better explain interindustry trade between developed countries, each one specialized in a variety of the good, while relative comparative advantages would still be the predominant explanation for trade with developing nations. However, as industrialization is not confined to developed countries anymore, especially in some industries that have strong economies of scale, the literature seems to be treating both explanations – scale and comparative advantages – as potentially reinforcing each other.

It is important to note that an industry can be capital-intensive at the same time it uses low-skilled labour, and that higher labour productivity can allow a workforce that is more expensive to still be more competitive in producing labour-intensive goods. Thus, potential multiple interactions regarding factor productivity can be in place to determine the relative comparative advantage of a country in a specific industry (Krugman et al, 2014 and Feenstra, 2015).

The comparative advantage explanations for trade assume constant returns to scale. The assumption of externalities (external economies of scale) was a next step, still assuming perfect competition. As we noted earlier in this chapter, the idea of external economies of scale can be traced back to Marshall, who argued that firms clustering around a geographical area would be more efficient than isolated ones because they would benefit from more availability of specialized suppliers, more availability of labour, and from knowledge spillovers among the firms in the cluster[39]. Although the intention to promote clusters and external economies of scale can be used as a reason for trade protection[40], it would also be possible to argue that trade liberalization allows more access to specialised suppliers in the form of imported inputs, as discussed in the previous section. Labour pooling would be indeed more likely in case of clusters, given the fact labour is usually less mobile. Finally, technology spillovers could be higher in either structure, depending on the assumption if technology spillover across

[38] Only after assuming imperfect competition did the trade models formally incorporate internal economies of scale, following the seminal monopolistic competition modelling of Dixit and Stiglitz (1977).
[39] A combination of initial comparative advantages and historical “by chance” events could have led to “first mover advantages” and then the consolidation of external economies of scale in that location.
[40] Free trade and concentration in worldwide single locations would be more efficient from the world point of view, but if the positive externalities do not perfectly transpose international borders, individual countries could have incentives to promote location within its own borders.

borders or are geographically concentrated[41]. Either way, since the understanding of the potentialities of externalities, industrial and trade policies focus on how to promote sectors with more potential external economies of scale.

Structuralist or evolutionist views emphasize the need to defy comparative advantages in order to promote development, and the underlying coordination role of governments. This view traditionally advocates for import-substitution policies and different types of the infant-industry framework. The objective of such policies is to create new dynamic comparative advantages, in sectors that could generate more technological spillovers and hence productivity gains to the economy, or to generate backward and forward linkages through the economy (Chang, 2009; Lin, 2009; Robinson, 2009; Rodrik, 2008; Warwik, 2013; Schapiro, 2013; and Astorga, Cimoli and Porcile, 2014). In other words, positive externalities.

The main criticism of the sectoral/structuralist approach is that the choice of targeted sectors is often based on weak economic considerations, subject to rent seeking behaviour, and lacks clear and enforceable conditionalities. A corollary of this would be that losing sectors would lobby harder and thus keep a status quo that is no longer efficient for the economy (Warwick, 2013; Baldwin and Robert-Nicoud, 2007). This view explains the condemnation of industrial policies from the 70's until the 90's, when the government failures were more highlighted and thus industrial policies in general were not recommended

The evolutionary economics focus less on productive linkages and more on technological spillovers than the structuralists, but both share a view that government support is needed to create comparative advantages in sectors with more potential to generate growth. However, as trade is a potential source of technology, the evolutionary view tends to be less prone to protection against foreign competition than the structuralists. According to Salazar-Xirinachs,Nübler,and Kozul-Wright (2014), evolutionary economics emphasizes the need for supporting institutions that enable

[41] The literature lists various ways for firms to acquire technologies: in-house R&D; state-led R&D; adoption of technologies embebbed in imported goods and machinery; copy of a competitor`s technology; and learning-by-doing externalities are among the most cited. However, a crucial aspect in the technology upgrading is absorptive capacity - a function of the education level of the workforce and the conducive business environment and institutional conditions.

firms to learn, in sectors where the learning process could generate positive spillovers and then allowing the economy to acquire comparative advantages in upgraded sectors (Reinert, 2009; Cimoli, Dosi and Stiglitz, 2009a; Greenwald and Stiglitz (2013). Chang (2013), for example, argue that better capabilities and better learning dynamics can explain the success of Japan and South Korea in their process of industrial upgrading and development.

On the other hand, the neoclassical approach defends that a country should specialize in sectors where it has comparative advantages, not defying it. The basic assumption is that markets are efficient in channelling resources to its more productive ends, and, thus, any industrial policy should be done only in the presence of market failures, and after a careful examination of the potential government failures.

More recently there has been a convergence between these apparently antagonist visions. This hybrid framework combines features of neoclassical economics and structuralism, having Justin Yifu Lin, Joseph Stiglitz and Dani Rodrik, among other economists, among its main proponents (Salazar-Xirinachs,Nübler,and Kozul-Wright, 2014b). As an example of this type of hybrid models, there is Lin and Treichel (2014), who suggests a cost-benefit analysis to evaluate if it is worthwhile to try to defy existing comparative advantages. Their main point is that some sectors present growth potentials that can justify the risk of state intervention. This renewed approach keeps the belief that market failures can deter the technological transfer required to upgrade the economic structure and thus relying solely on existing comparative advantages would be pointless. On the other hand, they recognize the risks and costs of departing too much from the existing comparative advantages, thus suggesting that governmental interventions should be somehow market friendly (Lo and Mei, 2014).

Part of the recently converging literature see market and government failures as equal problems, resulting in recommendations more concerning the design of such policies and advocating an emphasis on innovation policies (Naude, 2010). Summarizing the recommendations, Rodrik (2008) argues that to improve the quality of industrial policies it is necessary to have: (i) a better information flow between the private sector and the government; (ii) the imposition of conditionalities and a clear timeframe for benefits; and (iii) accountability. Other

authors suggest a closer look at competition, as the protection of old firms could prevent its replacement by new – and more productive – ones (Owen, 2012; Acemoglu et al, 2013).

ISI was advocated since mercantilist times and arguably adopted by virtually all industrialized countries, including the United States, in its industrialization process. In the 20th century it was widespread in the developing world (Salazar-Xirinachs, J., Nübler, I. and Kozul-Wright, R. (2014); Chang, Ha-Joon (2002)). Nonetheless, ISI lost appeal after the 80s, among other reasons, because it appears that more export-oriented strategies had more success. This helped to shift the mainstream view towards an agenda with more pro-trade policies, including the adjustment programs negotiated by international organizations such as the World Bank and the IMF. The example of South Korea, by instance, was taken by both sides of the debate as a proof of their validity: it would be viewed by some as an example of successful ISI strategy, conjugated with export targets; or an example of successful export-oriented approach, and a negation of the principles of ISI. A third view focus on the special characteristics of the south Korean economy, that would be not present in other developing countries, such as, for example, the availability of funds from the United States after the Korean war[42].

2.4 Brief contributions of institutional economics, industrial organization, and endogenous growth models

Institution and the business environment

Institutional economics studies how different institutions shape the behaviour of agents, through an evolutionary process that also consider the interaction of

[42] The main differences between the South Korean and the Latin American industrialization experiences, and that can explain why the South Koreans were more successful are: a) South Korea had preferential access to the US market and to US funds, in a cold war context; b) South Korea had access to technology spillovers from Japan; c) South Korea incentive exports, as its domestic market was quite small and the country had not enough natural resources to provide foreign currencies; d) South Korea did not neglect its human capital; e) South Korea implemented a system of tax incentives and export targets to force domestic firms to increase productivity and quality; f) South Korea firms had access to imported inputs (drawback), favouring the competitiveness of final goods. In this sense, South Korea chose industries, favouring mainly final goods ones. (Baumann, 2002).

physiological and legal aspects faced by each society. In a broader sense, following the definitions provided by Douglas North, Institutions are a set of rules and organizations that frame the way a society functions, guiding behaviour and interaction among members of that society. “At a time when the modern economy is becoming increasingly institutions-intensive, the reduction of economics to price theory is troubling enough. It is suicidal for the field to slide into a hard science of choice, ignoring the influences of society, history, culture, and politics on the working of the economy” (Coase, 2012).

The so-called New Institutional Economics – NIE - merged concepts related to institutional economics with neoclassical economic modelling, formalizing the effects of property rights and transactions costs, and he interaction of political agents (public choice theory), for example. As proposed by Coase (1960), for example, property rights allow for negotiation among economic agents, and this can even solve externality problems. The NIEs includes the work of Ronald Coase, Douglas North; Oliver Williamsom; and Daron Acemoglu (2001)43. As proposed by these scholars, institutions can drive capital accumulation and investment decisions and promote cooperation among members of the society. Put it simply, institutions can not only set the path for the society and economic agents, providing the right (or the wrong) incentives, but can also potentialize or minimize given positive or negative characteristics of a society.

Torvik (2016) points that Rodrik, Subramanian and Trebbi (2004) found that, although geography impacts institutions, intuitional quality is the single most important variable to explain income differences among countries, while trade integration is explicitly shown as to be not important, when institutions are taken into account. The most relevant institutions to promote investment, according to the literature, are the rule of law (including property rights and contract enforcement), the quality of the public sector in general (including regulation), and the political freedom (Menyashev et al, 2011). This relationship is supported by econometric evidence, that confirms that institutions affect development, although there is also an opposite view, arguing that the level of development implies the quality of institutions (Menyashev et al, 2011).

[43] Examples: Coase (1960); North (1990); Williamson (1975); Acemoglu (2001).

The business environment can be understood as how easy is to setup and manage a business in a certain country. The easiest it is, the more investment is made in that location, thus potentially positively impacting productivity and growth. Acemoglu and Robinson (2012) present the idea that bad institutions can be in the interest of incumbents that enjoy rents or benefits from the status quo. Torvik (2016), citing Hall and Jones (1999), stress that institutions and economic policies define the business environment for economic activities and innovation.

The balance of power within a society can led to the choice of institutions that favour the group in power, even if detrimental to the society in general. More specifically, powerful groups may prefer "weak property rights" as a way to keep institutions bad for outsiders, that would then be unable to compete with the political powers of the incumbent group (Torvik, 2016). An explanation of how some societies were able to overcome rent-seeking and promote better institutions can be found in the literature that shows that institutions develop incrementally, as put by North (1991).

Moreover, as mentioned by Nunn and Trefler (2014), the usual channels for institutions to affect trade are through institutions favouring the accumulation of production factors; or the design of certain economic policies; or the rise of per capita income. All these have impacts on the comparative advantage of a country. Particularly, bad institutions or bad business environment can produce a tariff structure that incentive low-skill industries and then incentive low skill comparative advantages. This is closely related to the argument present in Saure (2007) and revisited in this thesis, with the difference that it goes further linking the choice of tariff structure to a bad institutional/business environment.

There are, however, occasions when policies and reforms increase even more the economic and political powers of already dominant groups. In this case, such reforms can make ever difficult to promote future reforms aiming to reverse the initial path: "(…) one should be particularly careful about the political impacts of economic reforms that change the distribution of income or rents in a society in a direction benefiting already powerful groups. In such cases, well intentioned economic policies might tilt the balance of political power even further in favour of dominant groups, creating significant adverse consequences for future political equilibria." (Acemoglu and Robinson, 2013, p. 189).

Internal economies of scale, competition, and monopolistic competition models

Monopolistic competition with differentiated goods combines both a price and a non-price competition, as it allows some market power to the firms, based on the perceived quality or other differentiating aspect of their products. As in the perfect competition model, it contains many firms and the low entry and exit barriers keeps the economic profits close to zero (in formal models, at zero). The differentiated goods are possible because consumers demand choice options or different consumers have different tastes. Either way, it is assumed that consumers only imperfectly substitute these goods: the demand curve inclination will reflect the degree of this substitutability. Moreover, under a monopolistic competition market structure it is assumed that firms are small enough in relation to the whole market and therefore they do not take into consideration the production and price decisions of their competitors. Oligopolies, for instance, are markets with fewer firms, more market power, and strategic interactions among those firms, that chose the best combination of price and production based on the likely responses of their competitors.

Under oligopoly the degree of competition would be a function of the number of firms and the degree of product differentiation, as both aspects contribute to the degree of market power of each firm. However, oligopolies can exist both with homogeneous[44] or differentiated products. There are many oligopoly models showing how firms would optimally choose their strategies based on some assumptions. In some cases, the strategic decisions of firms can lead to price rigidity: if price reductions are followed by the competitors, and if price increases are not followed – thus risking losing market-share, the firm will tend to do not change its prices. The result is built on the assumption that goods are imperfectly substitutable (differentiated) and thus the result can be similar to monopolistic competition models[45]. This oligopoly model is refereed

[44] Thus, some source of entry barrier needs to be in place, such as sunk costs, scale economies, government regulations and so on.

[45] The striking difference is that under monopolistic competition firms decide their production levels and prices independently of the potential reaction of other firms, while under oligopoly the decision is taken after predicting the eventual reactions of competitors.

as the Kinked demand curve, and accordingly to our insights it is an oligopoly model that could eventually describe the Brazilian market of cars and light commercials production.

Ceteris paribus, the degree of product differentiation affects the market power in both oligopolies and in monopolistic competition models. As Stiglitz (2017) explains, in the benchmark Dixit-Stiglitz model prices could still be above marginal costs (thus, not reaching perfect competition) if the number of producers increase but there is still enough product differentiation.

Monopolistic competition models, initially formalized by Dixit and Stigltz (1977), were later used to show how internal economies of scale with differentiated goods can explain international trade (as in Krugman, 1980). If international trade thus promotes specialization of each country in each differentiated good, these models could also explain how international trade could induce internal economies of scale through specialization. Monopolistic competition models were also used to model other results, as for example the assumption of heterogenous firms, explaining how average productivity increases with trade liberalization, as in Melitz (2003).

With differentiated products and internal economies of scale[46], trade liberalization can induce specialization, but it is not possible to know a priori the pattern of geographical concentration. In fact, Krugman (1995) suggests that comparative advantages would be more important as an explanation for trade among different industries[47] while scale would better explain intra-industry trade, but their relative importance would be given by the differences between each pair of countries.

[46] Higher internal scale could be achieved through protection, if there are "national champions" reaping the benefits of higher domestic market-shares. It could also be provided by trade liberalization, if domestic firms reach foreign markets and are able to expand production to levels higher than otherwise possible solely on its domestic market. A third possibility is the discriminating monopoly pricing, suggested by Krugman (1984), where the firm charges a higher price in its protected domestic market, and a lower price in its export markets.

[47] But Krugman (1995) also consider that trade between different industries can be caused by scale differentials, as there could be a first move advantages originated in historical accidents, for example, that allowed some country to start producing and gaining scale before its competitors, and then reinforcing or mitigating previous comparative advantages.

Given this uncertainty of location pattern, Krugman (1980) explains that the existence of scale gains is in the core of the arguments for some level of protection in the development process, but also provide indications of the limits and potential costs for government interventions. A subsequent development is what is called New Economic Geography literature. Its main conclusion is that what a country produces in the present time has impact on its comparative advantages in the future and thus on the pattern of spatial agglomeration, given the increasing economies of scale. Thus, without government intervention, industries tend to concentrate where they can exploit internal and external scale economies, contributing to what is called “agglomeration economies”. In this sense, free trade would promote a spatial concentration (cumulative causation) of industrial sectors towards regions with better conditions to exploit these scale gains (in other words, were it is cheaper to produce, in face of previous investments and production capacity and higher productivity levels, not necessarily lower labour costs). The main force to prevent such spatial concentration are transport costs. Therefore, with free trade, the result would depend on the magnitude of each of these factors, and the current location of industries would affect the future comparative advantages of each region (Fujita et al, 2001; Krugman, 1991; Hausmann et al, 2014; Veblen (1898) and Myrdal (1957)). Therefore, this assessment has been used to justify protection.

Protection can lead either to lower or higher scale of production within the country. Less protection and the consequent integration into GVCs, for example, can lead to specialization and scale gains. The main channels for these results are then: a) Reallocation of market shares, with production going towards more efficient firms (as, for example, in Melitz, 2003); and b) Firms concentrating on their best products. More protection can, on the other hand, help domestic firms to secure market-share and thus increase scale. Within the monopolistic competition model, one could argue that the exploitation of economies of scale could be (at least initially) facilitated by protecting the domestic market, and not by opening it up. The rationale is that protecting domestic firms until they gain enough scale could allow them to gain productivity and be prepared for a trade liberalization. Only then the gains from trade would be offered also to the domestic firms. This argument is in this sense similar to the infant-industry argument.

Kucheryavyy, Lyn and Rodriguez-Claire (2016) points that gains from trade increase with scale, because firms already specialized in activities with comparative advantages will tend to achieve higher levels of productivity as their production increases.

Krugman (1979), for example, says that trade enlarges market size, allowing for a better division of labour and thus higher productivity efficiency (thanks to specialization). This is then an argument for trade liberalization, to achieve higher internal economies of scale.

De Loecker et al (forthcoming) summarize the channels through trade liberalization potentially can promote a better resource allocation and thus growth: a)exit of less productive firms (a la Melitz, 2003 etc); b) access to better and cheaper inputs (a la Goldberg et al (2010) and Halpern, Koren and Szeidl (2015)); c) reductions in prices (a la Harrison (1994) and Levinsohn (1993)).

Melitz (2003) is part of the “new new” trade theory, that highlights a new channel through trade liberalization can give rise to productivity: less barriers to trade allows the more productive firms to expand, while the less productive would tend to die in face of more competition. The result would be an increase in the average productivity of that country. In other words, when protection gets lower, the maximum marginal cost that allows a firm to stay in the market also gets lower, and then less firms are able to compete. These best firms are already the most productive in the domestic market and, as they tend to gain market-share they tend to grow, what could trigger further gains. It is then an example of an improvement in productivity caused by better resource allocation.

Arguably, trade liberalization can boost x-efficiency, while protection would be increasing domestic profits, and, because of an income effect, increase willingness to leisure. However, protection could instead also increase the rewards from effort, as also pointed in the literature (Buffie, 2001). Buffie (2001) observes that the net effect of trade liberalization or protection on the competition faced by domestic firms is uncertain: while trade liberalization reduces the market power of domestic firms, can promote the exit of less efficient firms, and can induce x-efficiency and a search for scale gains, it can on the other hand reduce the domestic production to a point where there are very few firms and competition is weaker. The domestic market structure and relative competitiveness are then crucial in defining the likely outcomes.

Aguion et al (2015) build a model to show that industrial policies that favour sectors where there is more competition, or that helps to increase competition (usually not favouring just few firms) can have a positive effect on innovation and productivity. This would happen because these policies could make innovative firms decide to stay in the competitive market to innovate and enhance its productivity, and not deciding just to leave the market in search for monopolist rents. Their result opposes the recommendations from the traditional infant-industry argument, as this latter framework advocates for protection and concentration, not competition. “Thus, while (foreign) competition is damaging for domestic growth in the infant-industry model, here competition is always growth-enhancing” (Aghion et al. 2015, page 3).

Adding to this is Cimoli, Dosi, Nelson and Stiglitz (2009)b, for example, who points that in both successful cases of Japan and South Korea, private firms were not able to exploit excessive rents, thanks to the existence of domestic competition (even if among oligopolistic firms) and to the exigence of achieving efficiency in order to export. On the other hand, in Latin America firms were able to pursue rent seeking without credible limits and were not required to increase efficiency. “Ultimately, success or failure appears to depend on the combination of different institutional arrangements and policies, in so far as they affect learning processes by individuals and organizations, on the one hand, and selection processes (including of course market competition), on the other” (Cimoli, Dosi, Nelson and Stiglitz,2009b, p. 28). As they point specifically in the case of Latin America, “governments could have created competition among domestic firms, which would have provided incentives to import new technologies. It was the failure to create competition internally, more than protection from abroad, which was the cause of the stagnation. Of course, competition from abroad would have provided an important challenge for domestic firms. But it is possible that in the one-sided race, domestic firms would have dropped-out the competition rather than enter the fray” (ibid, p. 32).

The results from international trade with imperfect competition then imply that protection could be necessary if one is to alter the trend of spatial concentration, in favour of the protected market. However, this protected domestic production would tend to be of reduced scale in comparison to what would be a scale under free trade. Another trade-off. Monopolistic competition and internal economies of scale provide a trade pattern were firms make the best possible combination of scale and variety, given the bigger overall market provided by trade (Krugman et al, 2014). Thus, trade increase market size, increase the availability of different goods to consumers, and allow firms to better exploit internal economies of scale. The pattern of country specialization and industrial location will depend on other factors such as relative comparative advantages, first move advantages (who started with more scale), transport costs, existence of other industries and external economies of scale, institutions, and so on.

Externalities and endogenous growth models

The international trade theory considered the effects of external economies of scale before formally incorporating the effects of internal economies of scale. However, the way external economies of scale were incorporated in the trade discussions was limited and seen as a distortion from the comparative advantages 'explanation (Krugman, 1995). The formalization of external economies of scale came with Helpman (1982), Romer (1986) and the "new growth literature"[48].

The endogenous growth models show how aggregated production can have non-diminishing returns, thanks to externalities (from physical capital, for example), even assuming perfect competition and diminishing returns at firm level. For this, endogenous growth models basically assume that a bigger population and a resulting higher number of researchers can generate more ideas, that ultimately generate more innovation and more per capita growth. Moreover, for this growth to be permanent the

[48] These were an advancement from the previous exogenous growth models: the Solow growth model (Solow, 1956) applies a neoclassical production function with constant returns to scale and diminishing returns to each production factor input. Given the diminishing returns to capital, it is expected a conditional convergence of income among countries. The model assumes that the technological progress is exogenous, and, therefore, it does not explain it.

models need to assume some form of externality – spillovers to other firms or sectors[49].

While Marshal (1920) pioneered the analysis of external economies, focusing on positive externalities arising from geographical agglomeration of industries[50], a subsequent Arrow (1962) assumed that physical capital embodies technology and modelled the process of "learning by doing", showing how technological knowledge and then productivity could be enhanced thanks to increases in total time devoted to industrial production. Frankel (1962) is also a learning-by-doing model, and, as Arrow (1962), assumed that technology evolves by chance. These were among the first tentative to endogenize technological progress, as a function of the stock of physical capital (machinery). Others developed the so-called "AK-model", were permanent increases in the investment could generate permanent increase in the growth rate: Romer (1986) modelled externalities associated to knowledge, and Lucas (1988) externalities associated to human capital, for example. The presence of externalities basically allows a growth model to exhibit non-diminishing returns, if all the necessary conditions are met.

But after Romer (1990) the literature had models that truly described the process of endogenous growth. As explained by Jones (2019), Romer (1990) pioneered explaining how entrepreneurs, seeking to maximize profits, would invest in nonrival ideas that would then allow an indefinite growth.

Endogenous growth models imply that indefinite growth can be achieved if there is either externalities or imperfect competition (allowing for private rewards from investments). As suggested by Jones (2019), after these models we have a clear role for policies that enhance investments in sectors with more externalities` potential, instead of relying on pure market forces. "Romer (1990a) imports the models of imperfect competition developed by Dixit and Stiglitz (1977) and Ethier (1982) into growth theory (…) This allows them to charge a mark-up over marginal cost, subject

[49] Only in the presence of enough externalities it would be possible to have a permanent economic growth. Increases in the investment rate or increases in the share of people engaged in R&D would only affect growth through a transition path. While these changes will increase the per capita steady state income of the country, they will not increase permanently the economic growth rate.
[50] Ciccone and Matsuyama (1996) provides a brief review of these developments.

to imperfect competition, and to earn the profits that ultimately serve as the carrot that motivates the search for new ideas".

The next generations of growth models consisted in what is called Schumpeterian models (Aghion and Howitt (1992) and Grossman and Helpman (1991), among others), were innovations are more disruptive and can entirely substitute previous technologies, instead of only gaining a small market share in a love for variety framework (Jones, 2019). Other recent models followed different paths, including some "semi-endogenous" models, where externalities affect income levels but not growth, and models where the flow of ideas is not as free and costless as previously modelled (Ramondo et al, 2016).

Rodriguez & Rodrik (2000) summarizes that endogenous growth models (either the ones where growth arises from the non-diminishing returns to capital, or the ones where growth arises from any form of endogenous technological change – such as learning-by-doing, for example) implies that protection is detrimental to the world growth, but that, depending on country-specific technology levels and factor endowments, protection could rise growth for the country instead.

If externalities do explain long term growth, one consequence is that bigger markets could potentially grow faster. But as "big" we can refer to either a country or a trade agreement area, or even a world liberalized market. However, as summarized by Ramondo et al (2016), while endogenous growth models such as Romer (1990), for example, show external scale arising from ideas as the main driver for growth, and therefore country size do explain growth[51], other models, such as Kortum (1997) and Lucas and Moll (2014) see externalities with much less force. Arguably, these last models make better sense of the empirical data, as it is clear that not always bigger countries grow faster.

Ramondo el al (2016) proposes an explanation for the difference between data and endogenous growth models prediction about the supremacy of bigger countries:

[51] Ramondo et al (2016) also acknowledge that it would be possible to argue that smaller countries tend to be more open to trade, thus offsetting part of the advantages of bigger countries.

incomplete domestic integration can explain why some countries benefit from their size more than others. When the domestic market is too fragmented and distances make trade costs within the country more costly, there is less scale effects to be generated. They also note that international technology diffusion explains most of the remaining difference between empirical data and theoretical models, but domestic integration would be the most important factor.

Domestic market integration can be viewed as a consequence of a better business environment and institutions, as we shall see later in this chapter. Assuming bigger scale is one of the key factors determining growth, and that this scale can be increased through domestic – and – international[52] integration, there is still the question of where technology and production will be generated or located. Production is located where there are cost-advantages and where more scale can be achieved. Thus, bigger markets have an attractive force based on scale (interacting with production costs), as well markets that are more integrated with global value chains. But the production location can be separated from the R&D location. As R&D is assumed to be the main generator of externalities and then growth, how its location patterns can affect the effects of trade liberalization? Arkolakis et al (2018) set up a model of heterogenous multinational firms operating in a monopolistic competition and found that countries that hosted most R&D facilities gain more from trade liberalization.

The relationship between these endogenous growth models and the international trade depends on the assumptions considered. The supply of ideas would be bigger in a bigger economy, thus indicating that trade liberalization would allow the participating countries engaging in the trade to mutually benefit from this larger flow of ideas - if the flow of ideas would be disseminated across these countries. Moreover, as ideas and research efforts are costly – usually modelled as fixed costs of R&D, a bigger market would also help to pay for these costs, therefore absorbing more R&D efforts. However, if knowledge does not easily spillovers across national boundaries[53], there could

[52] Either because of larger markets and also because of easier technology transfers.

[53] **This "spillover" does not need to be an unintentional by-product of production but could be a deliberate policy from the knowledge-generator country or from the knowledge-recipient country, resulting in technological transfer. Moreover, countries could absorb some of the knowledge through imports of intermediate and capital goods.**

be a concentration of benefits in the country were most of the production or R&D activities is done. Thus, if this happens, protection would be an alternative way to foster domestic production and generation of R&D and knowledge spillovers. But the protection alternative itself rely on another assumption to be able to fulfil these objectives: it needs to promote the growth of domestic production and R&D that is either bigger and at least as efficient/quality than what would be possible under a more liberalized trade, and the time to be able to do this need to compensate for the costs involved in the process.

As in Buffie (2001), countries with a larger R&D activity and a larger stock of knowledge would then have a comparative advantage that would make them concentrate R&D activities. If knowledge does leak between countries, countries with less comparative advantage on R&D can absorb some knowledge[54] and therefore the world as a whole would benefit thanks to more specialization.

Thus, protection imposes a high risk of vicious circle of isolation, and the main variables to consider are the cross-border potential for technology flows and the minimum viable scale for the target innovation and the possibility of doing that at all (time and capacity, measured as distance from that innovation), within the domestic market.

For example, there is a vast literature that focus on the importance of domestic capabilities to absorb foreign innovations. Furthermore, institutional and business environment constraints such as the quality of contract enforcement and the supply of IT infrastructure, can make R&D efforts more or less productive. The need to take into consideration other factors than simply investing in R&D is shared by Buffie (2001), that cites Romer (1990) and others as examples of the literature that point to the need of specialized inputs and good institutions. This question is then potentially more affected by the business environment than to the tariff structure. A further variable is the

[54] Foreign technology could also be acquired from FDI, human interaction, or international trade, but the process involves costs and also the existence of sufficient adoption capabilities. Domestically sourced technology is potentially cheaper to acquire, but the overall cost-benefit needs to take into account the “quality” or “potential” of these technologies.

integration of the domestic market, as pointed by Ramondo et al (2016). This can be understood as an argument for better physical integration (through infrastructure, for example) and for more and better contractual relationships (rule of law and other investment climate variables).

In this sense, endogenous growth models can also provide a theoretical foundation for protection, sharing the rationale behind infant-industry models: if a country is able to identify the “right” industry, this one could be temporarily protected in order to generate externalities and thus enhance long-term growth. Among formalizations of the infant-industry argument using the basis of endogenous growth models we have Grossman and Helpman (1991) and Matsuyama (1992), for example. Furthermore, Mendoza (2010) points that some growth models (such as Lucas, 1988; Young, 1991; and Matsuyama, 1992) predict that countries with backwarded industrial sectors could lose from trade liberalization.

However, externalities can also be viewed as a reason for trade liberalization. Mendoza (2010) cites some endogenous growth models (Chuang, 1998; and Goh and Olivier, 2002, for example), that can predict cacthup with trade liberalization. These models assume that the backwarded country could benefit from learning by doing through exports and through imports of intermediate and capital goods.

2.5 EMPIRICAL EVIDENCE ON THE EFFECTS OF TRADE ON COMPETITIVENESS

The achievement of internal and external economies of scale

As seen in the previous sections, the achievement of internal economies of scale has added to comparative advantage in explaining the competitiveness of industries and countries when trading worldwide. This competitiveness is also important to explain production location decisions, together with transport costs and industrial, trade and competition policies. The search for scale gains and the consequent spatial concentration can be a source of dynamic competitive edge if the R&D efforts undertaken in these locations does not spillover through national borders. If this is the case, effort must be done do attract the location of such activities. However, if enough technological spillovers do occur, international location of R&D does not matter for dynamic growth, and trade liberalization gain more support – as it will promote specialization and spatial concentration.

Aiming to increase the likelihood of domestic production, the typical trade structure used by developing countries (and developed ones as well, even in a smaller scale) is the one with positive effective protection, where inputs are less protected than final goods. This tariff escalation aims to incentivize domestic value-added. Moreover, if enough scale is obtained in final goods production, policies with lower protection for intermediate goods in conjunction with higher protection for final goods (usually seen in the 60s) could be a good combination for the achievement of external competitiveness (Thoburn, 2002). However, without proper scale gains the competitiveness of final goods is compromised. The most recent endogenous growth models reviewed in the previous sections point to the need of having access to better and cheaper inputs, produced at higher scale – either domestically produced if there is room for it, or imported. This last option is usually the one that comes with higher scale and also has advantages in terms of technology spillovers, although part of the literature sees the specialization on final goods as potentially detrimental if a domestic intermediate sector is viewed as important for the competitiveness of final goods and also for the overall pattern of industrialization. Therefore, according to this view, the lack of good and efficient intermediate goods would be a barrier to the production of more developed final goods (Young, 1928), and a stronger domestic intermediate sector could mean more employment, income, and further domestic productive linkages (Hirschman, 1957).

Thus, in this discussion of trade liberalization for inputs versus domestic production of the same inputs, a debate emerges between specialization versus diversification. As we shall see in later paragraphs, local content requirements are another policy that tries to foster the domestic production of diversified inputs using protection (although it can also be used to specialize in some inputs) while the participation in Global Value Chains tries to foster specialization in specific goods or even industries using market forces. The common ground is the search for domestic scale of production. In this sense, Kucheryavyy, Lyn and Rodriguez-Claire (2016) points that gains from trade increase with scale, because firms already specialized in activities with comparative advantages will tend to achieve higher levels of productivity as its production increases.

Another industrial policy strategy, followed by South Korea, for example, consists in what Krugman (1984) calls "protection as export promotion": a country protects its domestic industry to allow for scale gains and lower marginal costs, being able to price-discriminate and then to export at lower prices (than the ones charged domestically).

Both strategies can be designed to allow a country to gain comparative advantage in sectors it had not. In the case of protection or local content requirements, the induced local production is expected to show inter-industry externalities, with consequent improvements in productivity in other sectors and better potential for new (horizontal changes) and better (vertical changes) varieties (Hausmann and Klinger, 2006, Hirschman (1957), Succar, 1987, Young, 1991, and Greenwald and Stiglitz, 2006). Hausmann and Klinger (2006) for example say that the speed that a country can undergo a structural transformation depend on the "density" of economic activities it has in the areas nearby its current comparative advantage areas. This is a more detailed and complete argument than the papers that do not take into account the different "distances" between the current good and the production of a new one or new variety. As examples of these "simpler" – although crucial - papers on product variety we have Grossman and Helpman (1989 & 1991), and Aghion and Howitt (1992). Another strand focus on the difference between new goods and better goods (when there is just an improvement in quality). Albert Hirschman (1957), nonetheless, focusses on a specific type of clustering condition – the availability of backward and forward linkages – to explain why a "denser" economy is desirable to promote structural transformation. Moreover, local content requirements have the same effect as protection, thus also potentially being justified if they generate enough Marshallian externalities. Harrison and Rodriguez-Clare (2010).

Veloso (2006) summarizes the subsequent literature on this, saying that most of those papers condemned local content requirements as a welfare-reducing policy. He argues, however, that those studies (such as Lahiri and Ono, 1998, for example) do not take into consideration the potential dynamic benefits arising from positive externalities. Veloso (2006) stressed that the empirical literature shows that there are examples of successful policies of LCRs, and these successful ones are due to local content policies set up at reasonable levels, that encouraged scale gains and that kept a reasonable level of competition within the protected sector.

However, as seen in the previous sections, there is still a risk that protection for inputs or local content requirements[55] can undermine the competitiveness of final goods - the net result will depend on the price-elasticities of both goods (Grossman, 1981). Stone et al (2015), for example, stress that local content requirements are a barrier to efficiency gains (given its suboptimal resource allocation) and deterrent to the innovation that could have happened if the economy were able to access better foreign inputs. They also point out that the literature shows that LCRs can deliver some good results in terms of employment and income in the short-run, but that there is usually a long-run negative effect on competitiveness. The authors emphasize that, as these policies negatively affect trade in intermediate goods, the immediate risk is not to fully participate in Global Value Chains. The following consequence is the rise in costs throughout the domestic production chain, bringing loss of production efficiency and competitiveness, and the potential loss in dynamic efficiency caused by lower productivity and innovation (which in turn was caused by the lower influx of more advanced inputs). These effects are even bigger when the local content is set up in the beginning of the production chain and when it is widespread in the economy. However, positive externalities could indeed arise from local content requirements, and therefore the welfare result will then be driven by the balance between gains for the producers of protected goods and losses for consumers of that good (Stone et al, 2015).

Veloso (2006) points out that the use of policy to attract FDI to the automotive sector was always widespread. Moreover, local content requirements are used to leverage the potential vertical positive effects of FDI throughout the value chain (basically, backward linkages), and is likely to increase domestic welfare, as it helps to promote

[55] Export performance can be allowed to fulfil LCRs, as was the case in the South African industrial policy for the automotive sector.

internal economies of scale. However, LCRs can either promote the industry, or destroy its competitiveness, as there is a risk of domestic autoparts being too costly, thus reducing the competitiveness of the domestic auto sector. (Natsuda, Otsuka and Thoburn, 2015).

In general, this literature suggests that the presence of learning by doing, technology transfers and scale gains could provide benefits that would mitigate at least some of the negative effects of LCRs. Specifically, regarding learning by doing, the literature states that learning-by-doing through learned experience gained from higher production levels could lower production costs. However, it is not clear whether the domestic production cost would fall below the cost of the foreign input producer, which would be needed to justify the LCR. Thus, there is no clear evidence that those benefits will in fact outweigh the discussed negative effects. Moreover, as noted, LCRs may discourage technological transfers by reducing imported inputs and reducing investor's willingness to invest.

As cited by Veloso (2006), the empirical literature on LCRs is mixed: part find the policy is flawed (because of sub-optimal firm sizes and because of higher rents generated by lower competition) and part find the policy successful (mainly through a better exploitation of economies of scale and assuming there is enough competition in the input sector).

Lower trade protection would promote a specialization more driven by competitive forces, and therefore by initial internal economies of scale and comparative advantages. Trade augments market size, and this allows for a better exploitation of the division of labour, specialization, and productive efficiency (Krugman, 1979, based on Adam Smith). Thus, the engagement in GVCs could be a safer bet in terms of achieving the efficient scale in some sectors. Participation in GVCs could happen through the import of intermediate goods and services intended for a domestic assembly operation or through the sale of intermediate goods and services to foreign markets, or even through the sale of final goods to a foreign retailer.

Furthermore, it is well known that clusters can enhance competitiveness through specialization and economies of agglomeration, and they can be connected to GVCs, contributing to further specialization in a potential virtuous circle. For more on this see De Marchi et al (2018).

What stands out is that the participation in GVCs can bring benefits in the form of more value added in that production (Milberg, Jiang and Gereffi, 2014), or more scale (Kowalski et al, 2015), and these have a positive impact on productivity.

The automotive industry is the second in GVC activity (measured as the percentage of foreign value-added in the exports), and the electronics industry is the first (Natsuda, Otsuka and Thoburn, 2015). If we take into consideration that the share of electronics in a vehicle is growing rapidly, it would be clear that vehicle production relies heavily on GVCs. As Natsuda, Otsuka and Thoburn (2015) point out, major first-tier suppliers are operating globally and usually follow the automakers in their location decisions. Moreover, as the authors also remember, these suppliers are increasingly producing complete systems, increasing their value-added and becoming a more important driver of GVCs.

Milberg, Jiang and Gereffi (2014), citing Pietrobelli and Rabellotti (2006), define industrial upgrading as the possibility to produce more skilled products, better quality products or to produce it more efficiently, which, within the GVCS, are ways to ascend in the value chains, often adding value in the production. On the other hand, Kowalski et al (2015) argue that the exclusive focus on the pursuit of more value-added activities within GVCs could be misleading, because an increase in production volume (even in lower value-added activities) could also be beneficial. Despite this controversy, what stands out is that the participation in GVCs can bring benefits in the form of more value added in that production or more volume (scale), and these have a positive impact on productivity.

It is also important to consider that FDI and trade liberalization are not the only strategies that can foster participation in Global Value Chains. Other types of contracts and outsourcing can help to link the domestic economy to foreign sources of demand and suppliers of technology (UNCTAD, 2011).

Foreign and domestic competition[56].

Here we discuss channels that rely on firm-level decisions caused by competition pressures. In other words, it comprises efforts to make better, at firm-level, including the discussion on how competition impacts innovation.

A potential drawback from protection, not always foreseen by its proponents, is that protection can induce the entrance of new competitors in a sufficient number to reduce the average market-share and scale in the domestic market. These new entrants are probably less efficient firms, as they can only enter after the protection is in place. This argument is in Horstmann and Markusen (1986) and can be understood as analogous to the arguments that protection allows inefficient firms to stay in the market, therefore reducing average productivity and increasing costs.

Melitz (2003) is part of the “new new” trade theory, that also highlights how trade liberalization can give rise to increased productivity: less barriers to trade allows the more productive firms to expand, while the less productive would tend to die in face of more competition. The result would be an increase in the average productivity of that country. In other words, when protection gets lower, the maximum marginal cost that allows a firm to stay in the market also gets lower, and then less firms are able to compete. These best firms are already the most productive in the domestic market and, as they tend to gain market-share they tend to grow, which could trigger further gains. It is then an example of an improvement in productivity caused by better resource allocation.

Hoekman and Javorcik (2004) provide empirical evidence based on previous studies showing that productivity at plant-level grew after trade liberalization episodes, pointing at both reallocation effects and mark-up reductions as direct consequences of the increase in competition faced by those firms.

[56] It is necessary to point that here we are assuming that more imports would mean more competition, but this is not necessarily true if the imports come from other plants within the same multinational, just substituting its own domestic production without changes in prices, or if these inter-firm imports come to a domestic market where this firms is monopolistic.

Productivity arising from changes in X-efficiencies are the result of competitive pressures to reduce costs and increase innovation. However, although competition can provide incentives for firms to innovate, it can also discourage it, when there is a fear that no reward will be gained. The literature thus provides evidence of an inverted "U" relationship between the degree of competition and innovation: very low or very high levels of competition would generate low levels of innovation, while medium levels of competition would generate the highest levels of innovation.

Possas and Borges (2009) argues that neoclassical economics is more concerned with static allocative efficiency gains, and thus favour perfect competition, while evolutionary economics show that the most important thing for growth is dynamic efficiency and for this to happen there is the need of incentives and regulation that promotes innovation – not necessarily perfect competition. "(...) competition policies ought to be seen as the set of measures providing the incentives as well as the sticks fostering innovative behaviours. To reach this target, the simple guideline ` the higher the number of competitors, the better`, usually will not do. Indeed, we know from Schumpeter that such dynamic competition can be achieved even in oligopolistic industries – indeed mostly in such industries" (Possas and Borges (2009, p. 449)

As summarized by Peneder and Woerter (2014), the industrial organization literature does not reach a consensus regarding the effects of competition on innovation. There are theoretical and empirical results suggesting effects in both ways: competition being obstructive and competition being conducive to innovation. This literature usually relies on two main theoretical predictions: Schumpeter (1942; 2014) and Arrow (1962). Peneder and Woerter (2014) say that most studies, misinterpreting what Schumpeter said, assume that the Austrian economist defended a negative relationship between competition and innovation. The truth, however, would be that Schumpeter said only: a) that it is logically impossible for a firm operating in a perfect competitive market to innovate; b) the prospects of market power are conducive to investment in innovation; c) a monopoly is always contestable. Regarding Arrow (1962), Peneder and Woerter (2014) say that he agrees with the impossibility of endogeneity innovations in perfectly competitive markets. He also pointed out that firms in markets that are more competitive will tend to invest more in innovation than in non-contestable monopolies: this is because while the monopoly could expect to substitute the old rents for the new rents (generated by innovation), the firms in the more competitive setting could expect to see a larger difference between its new rents (generated by innovation) and its previous rents.

Therefore, as Peneder and Woerter (2014) explain, taken together these two fundamental works suggest, “neither perfect competition nor uncontested monopolies provide a market structure that is conducive for the creation of new knowledge” (Peneder and Woerter, 2014, p. 656). This means that these are not antagonist views, to the contrary of what is usually assumed by the literature. Moreover, they can be integrated in a common framework – an inverted-U relationship, as has been done in a successful strand of the literature initiated by Kamien and Scwartz (1976) but best represented by Aghion (2005).

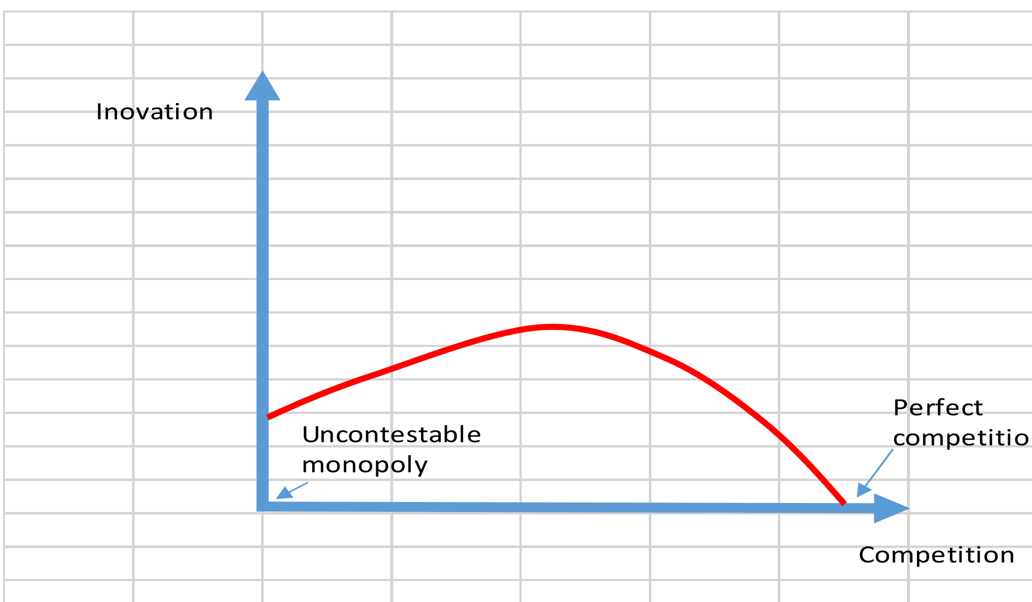
Utar and Ruiz (2013), discussing the relationship between competition and innovation, point to the two main antagonist views: a) “typical industrial organization theories” indicate that competition would reduce the rents and thus the incentives for innovation or upgrading, in a Schumpeterian fashion. Nonetheless, Aghion et al (2005) amend this view saying that if pre-innovation rents are lower due to competition, but post-innovation rents are higher, firms will invest in innovation in order to stay in the market. This is, according to Utar and Ruiz (2013), the reason for innovation and upgrading in the Mexican maquiladoras in face of Chinese competition, an interpretation aided by the idea that multinationals` subsidiaries compete among themselves for investments from their headquarters; and b) thanks to the fact that a cost-reducing innovation carried on by a monopolist would simply replace the source of rents, a firm facing competitive pressure would be more willing to innovate, in order to reduce its costs and thus try to stand-up (Arrow, 1962).

Competition has two antagonist effects on innovation (Aghion et al, 2005):
a) “escape competition effect”: higher competition reduces rents received by the firms in the market and then induces the firms to innovate in order to escape from the competition;
b) “rent dissipation effect”: higher competition reduces rents received by the firms that innovated, thus disincentivizing firms from innovate.

The net effect on rents and thus on innovation will depend on the technological gap within the industry: in sectors where firms are similar in terms of technological development the "escape-competition" dominates, as the probability of achieving higher post-innovation rents is higher (Peneder and Woerter, 2014; Aghion et al, 2005).

Aghion (2005) combined these propositions with the assumption that heterogeneity in technological levels (average technological differences) rises with competition. The outcome is an inverted-U relationship where in perfect competition innovation by laggard firms is low because "rent dissipation effects" are sufficiently high for these firms. Moreover, with incontestable monopoly innovation is also low, because such firm does not face any "escape competition effect". Figure 5 illustrates this relationship.

Figure 5 – Inverted-U relationship between competition and innovation.



Using the terminology of Aghion et al (2005), in an incontestable monopoly the firm will innovate very little, as it does not need to "escape competition". In a perfect competition environment, firms will also not innovate, but because they would face a massive "rent dissipation effect".

Peneder and Woerter (2014), analysing data from Swiss firms, also find evidence of an inverted-U relationship. They concluded that the possibility of multiple equilibria between competition and innovation suggest that industrial policies could play a role in promoting innovation. However, the empirical studies about the inverted-U relationship are usually aggregated, meaning they consider all industries. This does not allow for the examination of idiosyncrasies among different industries.

Kaufman (2013) remember that the Neoclassical theory states that optimal competition equals 100% competition, based mainly in the First Welfare Theorem (competitive equilibria is Pareto efficient – "allocative efficiency"). However, the author points that market-failures affect this statement in different levels, and that there is an optimal domestic competition equal to less than 100% competition. Duranton (2000), using a standard industrial organization model with increasing returns (that generates growth and imperfect competition and, ultimately invalidates the First Welfare Theorem), concludes that "There exists a growth-maximizing degree of competition". Singh (2003) reviews methodologies to analyse the intensity and effects of competition, concluding that the optimum level of competition does not appear to be zero or maximum competition. He further argues that the relationship between competition and incentive to innovate may be correct in some cases, but not necessarily always; that uncoordinated price competition has the disadvantage of maybe becoming so intense that it could cause instability in prices and ultimately dampen firms` propensity to invest; and finally, that it is not possible to say a priori that price competition would necessarily be more conducive to promoting social welfare and productivity growth than non-price competition.

Aghion et al (2015) argue that forcing a firm to compete in a sector that is already competitive increases its productivity. In other words, foreign and domestic competition are growth-enhancers. This is quite different from the infant-industry arguments, where foreign-competition is bad for domestic growth. The reason for the difference is because Aghion et al (2015) believe that firms will try to escape this competition resorting to innovations that ultimately will increase productivity growth.

The literature poinst to the variations in the degree and form of rivalry (be it domestic or related to foreign competitors) as one of the main explanations for the differences in the results of industrial policies around the world. Cimoli, Dosi, Nelson and Stiglitz (2009)b, for example, point outthat in both successful cases of Japan and South Korea, private firms were not able to exploit excessive rents, thanks to the existence of domestic competition (even if among oligopolistic firms) and to the exigence of achieving efficiency in order to export. On the other hand, in Latin America firms were able to pursue rent seeking without credible limits and were not required to increase efficiency. “Ultimately, success or failure appears to depend on the combination of different institutional arrangements and policies, in so far as they affect learning processes by individuals and organizations, on the one hand, and selection processes (including of course market competition), on the other” (Cimoli, Dosi, Nelson and Stiglitz,2009b, p. 28). As they point out specifically in the case of Latin America, “governments could have created competition among domestic firms, which would have provided incentives to import new technologies. It was the failure to create competition internally, more than protection from abroad, which was the cause of the stagnation. Of course, competition from abroad would have provided an important challenge for domestic firms. But it is possible that in the one-sided race, domestic firms would have dropped-out the competition rather than enter the fray” (ibid, p. 32).

Mayer, Melitz and Ottaviano (2014) highlight another source of productivity gains from trade: competition reduces markup levels and thus promotes within-firm concentration towards their best products. The authors found evidence of this analysing the behaviour of French exporters.

Hashmi and Biesebroeck (2016) found evidence that in the automotive sector more concentration and market power generates more innovation.

The automotive sector worldwide is very concentrated, and this trend has been driven by the need to fund more intense and expensive R&D – this outcome is not generating less competition, but instead more, as automakers are fighting for innovative edges (Hashmi and Biesebroeck, 2016 ou 2010?)

On top of the heterogeneity of results in terms of firms` characteristics, Schor (2004) also observed variations through time: immediately after a reduction in the tariffs on final goods, there is a reduction in productivity, caused by the smaller market share (and the subsequent reduction in the scale of production). The productivity (the real technical progress) rise as soon as the low-productivity firms need to do so in order to avoid bankruptcy. A slightly different dynamic happens when the tariffs on inputs are reduced: in this case all domestic firms (the low-productivity and the high-productivity ones) would benefit from the higher use of imported inputs and the consequent higher productivity.

Muendler (2004) researched the same topic as Schor (2004), with similar methodology, and arrived at similar results. One difference is that Muendler makes explicit the channel of an increase in productivity due to the shutdown of inefficient firms (which increases average productivity). The other channels are those already mentioned: (i) competition pressure from imports (the author cites the literature that confirms this channel); and (ii) availability of foreign inputs (always assuming that foreign inputs have a better combination of quality and cost). Another difference is that Muendler (2004) found the impact of foreign inputs to be less important than the competitive pressure and also less important than the exit from the market caused by more competition. A potential explanation, given by the author, is that it takes time for firms to be able to use the new imported input efficiently – if the firm can do it at all.

As pointed out by Peng, Riezman and Wang (2016), "Sizable productivity gains resulting from trade liberalization is documented for Brazil (Ferreira and Rossi 2003) and other countries" (...) "more substantial productivity gains are found in firms using newly imported intermediate inputs (see Goldberg et al. 2010 for the case of India)" (…) "trade liberalization results in lower mark-ups and greater competition (see Krishna and Mitra 1998 for the case of India)" (…) "firms facing greater competition incur significantly larger productivity gains (see Amiti and Konings 2007 for the case of Indonesia)".

The Schumpeterian approach emphasizes the link between economic incentives – entrepreneurship – innovations – creative destruction - economic growth. Quian, Araujo and Nucifora (2018) argues that creative destruction has been avoided by distortions of the Brazilian economy, thus breaking the link between entrepreneurship and economic growth. They examine how productivity growth evolved in Brazil, ate firm, sectoral and aggregated levels, and concluded that the main distortions that reduced productivity in the country are: restricted reallocation of resources between sectors; low capital accumulation and suboptimal allocation of resources; an environment where inefficient firms are allowed to survive, thanks to low competition. The authors go further to argue that these factors make firms in Brazil compete for public privileges rather than searching to gain productivity.

Bacha (2017) points to the importance of trade liberalization to improve productivity. According to him, this would happen thanks to a) the access to better technologies; b) the specialization and consequent higher scale of production; c) higher competition leading to the natural selection of better firms. Bacha (2017) affirms that every country that succeeded in becoming developed after the second world war did so because they promoted a growing participation in international trade. This, together with the fact that the Brazilian economy is among the most closed in the World, could explain why the Brazilian economy lags behind in productivity growth. The fact that Brazil receives a reasonable amount of FDI is no relief, because, as remembered by Bacha, this high FDI just means that multinationals are investing to benefit from a protected market, without truly promoting productivity growth.

Acemoglu et al (2013) also point out that subsidies to incumbent operations reduces growth and welfare; the optimal policy should incentive R&D irrespective of the firm, while encouraging the exit of less productive incumbents; as small and young firms engage more in R&D and grow faster than larger and older ones.

Access to technology

Employing qualitative and quantitative data, Otsuka and Natsuda (2015) studied if and how policies were able to foster technology – and productivity (TFP and labor) in the Malaysian automotive sector. The theoretical framework was the model of R&D spillover of Coe and Helpman (1995). “One of the most important implications of these models is that technological knowledge in other firms, industries, or countries influence the domestic TFP. This is referred to as knowledge spillover or R&D spillover and is considered to be a vital part of productivity growth. (…) The R&D spillover model in Coe and Helpman (1995) demonstrates that TFP depends on research efforts and includes two research variables: domestic R&D (RD) and foreign R&D (FRD). Domestic R&D is made up of the research efforts made by a firm in home country, and FRD is undertaken by firms outside of the countries. The R&D spillover model demonstrates that a firm can utilize technological knowledge created by others. One of the key features in the R&D spillover model is that TFP may depend on FRD — a positive externality from foreign technology".

We focus now on the effects on innovation and technology adoption, given the access to technology embodied into imported inputs and machinery, and effects on the quality and cost of production, given the access to inputs and machinery at international price and quality.

Technology and innovation are the main driver of productivity growth. The empirical literature usually points that outward FDI, exposure to export markets, and access to imported inputs (especially capital goods) embebed with foreign technology, are thus important drivers of productivity and growth.

There are two main sets of benefits brought by the access to imported inputs: lower costs and more technology/quality. And the main channels used by these models to explain the benefits of such access are through: a) static gains in terms of more revenue and/or market share, triggered by the possibility to have cheaper and better inputs; b) dynamic gains from the ability to create new products or variations. (Goldberg et all, 2010).

Halpern, Koren and Szeidl (2015) review the literature on the microeconomic effects of imported inputs on firm productivity. According to them, there is plenty of evidence that a trade liberalization in intermediate goods positively impacts the productivity of the economy. The authors point out that the channels for this to happen are: (i) the imports bring a better combination of price and quality (as modelled in Aghion and Howitt (1992), for example); and (ii) the imports bring more product variety (as modelled in Ethier (1982)). The authors, using data of Hungarian firms, found that foreign intermediate goods raise considerably the productivity of firms operating domestically. They also found that these gains are higher when the tariff cuts happen in an economy with already a substantial number of foreign firms. Halpern, Koren and Szeidl (2015) also point out that domestic suppliers of intermediate goods may face some relief from the fact that the demand for their products will probably decrease less than the amount of new imports: the increased productivity and output in the final goods sector may counteract the initial effect.

Goldberg et al (2010), analysing the trade liberalization in India during the 90s, found evidence that better access to imported inputs helped domestic firms to gain efficiency and to develop new products, in line with other empirical literature.

Saure (2007) developed a formal model departing from the infant industry argument to demonstrate that, under certain circumstances, trade promotes growth through the availability of foreign inputs and the learning possibilities carried by it. The model shows that when the initial conditions in the developing country favours the adoption of less advanced technologies, any restriction on the imports of inputs incentivizes the domestic industry to use the less advanced technology. Conversely, the access to imported inputs at world prices allow the developing country to participate in the global value chains, taking advantage of the technology embodied in the imported input and using it in the production of another good (while also producing complementary inputs). The assumption that domestic producers can chose a lower technology is reasonable and the literature admits that even technologically advanced goods can be manufactured using alternative low technologies (Lederman and Maloney, 2004).

Technology embedded into imported inputs can not only raise domestic productivity (as it can reduce production costs and/or increase efficiency, including in terms of quality), but can also contribute to increased domestic innovation (International Monetary Fund, 2018).

Tariffs can have different effects on the competition of a good: they provide protection for the producer of the good itself, but also increase cost for the producer of the final good that use the previous one as an intermediate good. These effects are well characterized in the literature on local content requirements, as discussed earlier in this chapter, and one way to measure the resultant effect is to use measure of effective tariffs, as proposed by Corden (1971). As pointed out by UFRJ (2015), this concept regained importance after the rise of Global Value Chains, where firms use foreign inputs to enhance their competitiveness. To measure the effective protection, we need to know the production technology of each sector, to calculate the relative importance of foreign inputs. Alternatively, one can calculate the nominal tariffs applied to each phase of the value chain.

For the productivity and quality/innovation gains the rationale is to open up to imported inputs with superior technology that could provide competitiveness (static and mainly dynamic) for the domestic final goods. The theoretical and the empirical literature are categorical that if a country insists on protecting a high-tech input sector without enough capabilities to efficiently produce that good, it can damage the prospects of the entire domestic value chain that could use that input, because: a) the domestic input turns out to be very expansive – thus reducing demand and production in the final goods sector (and subsequently reducing the demand for those domestic inputs).; or b) the domestic final goods sector chose to use lower technologies, not using the "high-tech" inputs[57].

A good example was the policy implemented in Brazil during the 80s to promote domestic microcomputer manufacturing. Luzio and Greenstein (1995) used an 8-year time series for price and performance of Brazilian-made microcomputers, evaluating the rate of advance using hedonic techniques, and then comparing the results to international standards, Although the rates of advance in price and performance of the Brazilian microcomputers were similar to international rates, there was never a catch-up: prices started almost 100% higher and kept almost 100% higher. The potential explanations given for the non-catching up was basically the higher input costs, as they needed to be locally sourced, given local content requirements. This seems to be evidence that trying to have domestic production of too many sectors or the entire value chain of most of these sectors can drag down the average productivity and the competitiveness of the economy, as there will be lower specialization and higher production costs.

[57] This is the argument behind the models that argue against the protection of inputs and criticize this aspect of infant-industry models.

As pointed out by Peng, Riezman and Wang (2016), Keller (2000) demonstrates how "technology can be transferred through intermediate goods trade", contributing to a literature going back to Ethier (1982), that pointed to the positive effects that trade in intermediate goods can have on final goods`s productivity. Peng, Riezman and Wang (2016) thus use his insights to dynamically model the effects that trade liberalization in intermediate goods can have on productivity and technology. The main assumptions and results are that "Trade liberalization (either domestic or foreign) reduces domestic intermediate producer mark-ups and increases final good output and average productivity. However, aggregate domestic technology levels fall. Hence, we see the tension that trade liberalization brings. Lower tariffs make more advanced technology cheaper leading to productivity gains. However, these come at the expense of domestic technology levels which fall in the steady state because the incentive for domestic firms to invest in improving their own technology is weakened. We found, numerically, that the negative effect on technology is smaller in less developed countries. So, the bottom line is that trade liberalization is good for productivity but bad for the domestic level of technology".

Schor (2004) found positive effects of trade liberalization through the increased use of imported inputs in Brazil following the trade liberalization of early nineties. These inputs contributed to the increase in firm productivity mainly through two channels: (i) increased competition within the sectors that produce those inputs; and (ii) access to the technology embedded in the imported intermediate goods, by final goods firms.

The empirical evidence on the nature of technological spillovers is one of only partial cross-border spillover. In terms of geographic distribution, by 2018 R&D investments remains heavily concentrated in the United States, with China growing rapidly and set to surpass the US very soon. However, if we look at the sources of R&D investments, most of it comes from private manufacturing firms – an indication that attracting and maintaining a manufacturing base is still important for R&D generation (Delloite and Singularity, 2018). Most R&D activities are concentrated around the headquarters of the multinationals, or in clusters located in developed countries, leaving little room for technological spillovers from the manufacturing activities located in developing countries (World Bank, 2018).

R&D investment worldwide is concentrated in large multinational private companies, with the automotive sector being among the top contributors, together with the technology sector, the pharmaceutical sector, and the electronic goods sector. Volkswagen invested 10,5 billion dollars annually, on average between 2012 and 2016, – the fourth biggest among all companies in the world, while Toyota invested on average 8,2 billion in Japan. At the same token, the biggest R&D investments made in the world came from Samsung (12,2 billion), Intel (11,4 billion), and Microsoft (11,4 billion). (Delloite and Singularity, 2018).

As suggested in Delloite and Singularity (2018), "manufacturers should plug into an innovation network and create bilateral or multilateral relationships that (…) serve as a feeder system for ideas/building blocks for the iterative development of breakthrough innovation" (page 24). This statement resulted from the acknowledgement that technology is evolving ever faster.

Effects on and from institutions in general and business environment in special.

This section discusses how protection levels and the business environment are related, and how one affects the other. The complementary views in this relationship are the following:

a) Less protection gives incentives for firms to lobby for better institutions and better business environment, as this become relatively more important for their competitiveness, as they cannot rely on protection to survive. Similarly, a good business environment would give better competitiveness conditions, and thus less need for protection.

b) Conversely, a bad business environment and bad institutions overall generate the need for protection. Moreover, a highly protected industry would prefer to keep this status quo rather than improve the overall business environment, as the protected firms would be able to lobby for special treatments allowing them to survive within the bad business environment while making it difficult for the competition to enter or to remain in the market.

A better business environment is among the necessary conditions to achieve competitiveness, together with increases in trade (Kalout et al, 2017), A poor business environment can cause lower TFP through:

- Entry and exit barriers (caused by a bad business environment or by protection against foreign competition) generates less incentives for firms to improve (as they face less challenges from new competitors and/or receive subsidies). It is not clear how these impact on average scale.
- Higher production costs (caused by a bad business environment or by protection against foreign competition).

Higher domestic integration (with better infrastructure), for example, could also increase productivity. A weak transport network can make it more difficult for integration of economic activities and full exploitation of the internal economies of scale: there is empirical evidence for Brazilian manufactures that in some sectors prices are very different according to the region were the product is sold (Goes and Matheson, 2017).

A process of structural transformation where productive resources are reallocated to uses with higher productivity contributes to economic development. As cited in Sebastian and Steinbuks (2017), the literature shows that public infrastructure helps to increase the productivity of private inputs because: a) it reduces fixed costs, thus lowering entry barriers, increasing competition, and thus increasing the growth of productivity; b) it reduces fixed costs, thus increasing the level of productivity; c) it contributes to the Marshalian economies of scale; d) it contributes to factor reallocation across sectors and firms.

There is a vast literature with convincing empirical evidence showing that institutions are indeed among the most important factors affecting the prospects of economic development. Among those, there is the New Institutional Economics, including the work of Ronald Coase, Douglas North; Oliver Williamsom; and Daron Acemoglu (2001)[58]. As proposed by these scholars, institutions can drive capital accumulation

[58] In a broader sense, following the definitions provided by Douglas North, Institutions are a set of rules and organizations that frame the way a society functions, guiding behaviour and interaction among members of that

and investment decisions and promote cooperation among members of the society. Among the most important (and measured) institutions affecting economic growth there is the existence of enforceable property rights, and the rule of law (Menyashev et al, 2011). As proposed by Coase (1960), property rights allow for negotiation among economic agents, and this can even solve externality problems.

There is also literature that does not focus on the impacts of institutions on proximate factor accumulation (Capital, labour and technology), but instead, can impact comparative advantage (Nunn and Trefler, 2014). This would happen through better contracts allowing more efficiency and competitiveness, especially in products that use contracts more intensively (Nunn, 2007). The quality of contracts proved to be important in determining export performance, both in cross-country econometric studies and in comparisons among firms within the same country ((Nunn and Trefler, 2014). There is also historical empirical evidence on the impact of trade on domestic institutions, where studies argued that trade volume and trade mix altered the balance of power within societies and therefore impacted in the chosen domestic institutions (Acemoglu et al, 2005; and Nunn and Trefler, 2014).

Torvik (2016), citing Hall and Jones (1999), stress that institutions and economic policies define the business environment for economic activities and innovation. "The main message in this literature is that institutions are main driving forces in explaining cross-country income differences" (Torvik, 2016, page 3). Torvik (2016) points out that Rodrik, Subramanian and Trebbi (2004) found that, although geography impacts institutions, instuitional quality is the single most important variable to explain income differences among countries, while trade integration is explicitly shown as to be not important, when institutions are taken into account. This relationship is supported by econometric evidence, that confirms that institutions affect development, although there is also an opposite view, arguing that the level of development implies the quality of institutions (Menyashev et al, 2011).

society. In a narrower sense, NIE seeks to understand how institutions affect the process of capital accumulation and investment. Examples: Coase (1960); North (1990); Williamson (1975); Acemoglu (2001).

The empirical literature on institutions usually rely on case studies or econometrics. Critics argue that it is difficult to generalize the results from case studies, while within econometric studies the difficulty is mainly how to find good instrumental variable to overcome the fact that institutions can be an endogenous variable (Lloyd and Lee, 2018).

A bad business environment favours big established companies, while punishing smaller start-ups. Moreover, a weak rule of law, uncertain macroeconomic conditions together with high interest rates, and complicated regulations, makes investment and contracts riskier and costly (Kalout et al, 2017). This is the scenario faced by Brazilian firms and also by the multinationals facing the decision of making FDI in the country. It is safe to argue that Brazil is among the 10 biggest FDI destinations mainly because of its domestic market size.

It is difficult to point to one specific aspect of the business environment in Brazil as the most important, but according to the available rankings the high interest rates are perhaps the safest bet: high interest rates make the costs of capital very high in Brazil, and can also contribute to a relatively overvalued exchange rate.

Protection can also reinforce a bad business environment, as previously suggested by Sachs and Warner (1995): trade liberalization …" forces the government to take actions on the other parts of the reform program under the pressures of international competition".

Overall, to reduce inefficiencies and promote the competitiveness of Brazilian firms the literature suggests[59], besides a reduction of tariffs and more trade agreements and even some exchange rate devaluation, a better business environment.

The balance of power within a society can led to the choice of institutions that favour the group in power, even if detrimental to the society in general. More specifically, powerful groups may prefer "weak property rights" as a way to keep institutions bad for outsiders, that would then be unable to compete with the political powers of the

[59] Bacha (2017) is an example of such literature.

incumbent group (Torvik, 2016). An explanation of how some societies were able to overcome rent-seeking and promote better institutions can be found in the literature that shows that institutions develop incrementally, as put by North (1991).

Pushing reforms to accelerate the evolution of institutions is hard, as they face the opposition of the negatively affected groups in power. Torvik (2016) summarizes the literature saying that the way forward is either to show who are the potential winners and make sure they are a majority, or to compensate the potential losers. In any case, the author also defends gradualism, as it gathers more political support. Another potential way to promote better institutions is allowing competition among political groups, be it among different governmental levels and agencies, or between competing groups seeking power through the vote. (Menyashev et al, 2011).

There are, however, occasions when policies and reforms increase even more the economic and political powers of already dominant groups. In this case, such reforms can make it ever difficult to promote future reforms aiming to reverse the initial path: "(…) one should be particularly careful about the political impacts of economic reforms that change the distribution of income or rents in a society in a direction benefiting already powerful groups. In such cases, well intentioned economic policies might tilt the balance of political power even further in favour of dominant groups, creating significant adverse consequences for future political equilibria." (Acemoglu and Robinson, 2013, p. 189).

Competitiveness and business environment Indexes

We present two international indexes to assess the quality of the business environment and also the competitiveness of manufacturing: The Competitive Industrial Performance Index, from UNIDO[60], and the Global Competitiveness Index 4.0, from the World Economic Forum[61], both for 2018, and both ranking countries in relative positions.

[60] UNIDO (2019)
[61] WORLD ECONOMIC FORUM (2018).

The Index from UNIDO is composed by measures of manufacturing value added and exports per capita; industrialization intensity and export quality; and the impact on world manufacturing value added and exports. It is measuring the outcomes in terms of performance and is based on very objective data.

The 2018 UNIDO competitive industrial index showed Germany as the most competitive nation for manufacturing in the world, followed by Japan, China, the United States, South Korea, and Switzerland. The United Kingdom is the 16th, while Mexico is the 20th, Malaysia 22nd, Poland 23rd, Thailand 25th, , Turkey 29th, Russia 32nd, and Brazil 35th , slightly better than Indonesia (38th) and India (39th). South Africa falls behind in 45th, as Argentina 49th. African countries make the most positions between 103rd and 150th.

It is striking the fast rise of China, that was the 29th in 1990, and the 19th in 2000. On the other hand, Brazil lost positions in the index, from 2010 to 2018, while had a relatively stable position between 1990 and 2010. The exception was the dimension related to “technological deepening and upgrading”, where Brazil felt between 1990 and 2010, but is stable since 2010.

On the other hand, the Global competitiveness report, from the World Economic Forum, ranks 140 countries. The index measures factors that are arguably underlying determinants of competitiveness, including some directly related to institutions and business environment. The first places were the following:

1 United States

2 Singapore

3. Germany

4. Switzerland

5. Japan

6. Netherlands

7. Hong Kong SAR

8. United Kingdom

China is the 28th, India 58th, Brazil 72nd.

Within the Brazilian ranking, the most negative aspects were macroeconomic stability (sustainability of fiscal policy) in the 122nd position; and product market (low exposure to foreign competition and existence of severe market distortions) in the 117th position. The best performing aspect were on its market size (10th).

Overall, the picture that emerges from these two indicators is that Brazilian economy suffer from a bad business environment, caused by fiscal difficulties, high interest rates, and high levels of distortions/low levels of competition in the product market. This business environment is damaging the prospects of industrial competitiveness, and reliance on the size of the domestic market is clearly not enough.

However, we ask why China is the second most competitive manufacturing country, according to the UNIDO`s index, and only the 28th more competitive economy, according to the Global competitiveness report? In other words, what are the elements in the World Economic Forum index that apparently did not impact the Chinese manufacturing competitiveness? The best Chinese indicator, by far, is the size of its domestic market. This seems to be the explanation for its manufacturing competitiveness – scale – despite a not so good relative performance in other indicators. But China does not perform badly in most of the other indicators and is better in all indicators compared to Brazil.

Interaction among dynamic externalities, foreign competition, and access to technology: the case for infant industries

The empirical evidence for infant industry arguments is weak. "The empirical evidence bearing on the infant industry argument is limited and indirect. It is not clear that anything meaningful can be inferred from the fact that many industries have remained dependent on protection for a very long time. Governments adopt protectionist policies for a variety of reasons; a proper test of the infant industry argument would therefore have to isolate those industries where infant industry considerations were the primary motivation for protection" (Buffie, 2001, page 64). In our case study this is not possible, as there were different potential motivations for the protection of the Brazilian automotive sector since the 50s: learning by doing related to infant industry arguments; domestic linkages and external economies of scale; internal economies of scale; current account deficits; R&D; employment and income etc. And those motives were not clearly stated, nor properly measured.

Moreover, the difficulties in gathering the necessary data and the political risks of the government being captured and allowing a higher and permanent protection can increase the costs of such policies: "The governments of S. Korea and Taiwan were able to precommit effectively to temporary protection (Lee, 1997; Pack, 1988, p. 339), but it is obvious that this feat would be more difficult to replicate in many other LDCs where policy makers have a long history of imposing tariffs and quotas to shelter domestic firms from foreign competition" (Buffie, 2001, page 65). This risk seems to have materialized in the Brazilian case, as can be inferred from the perpetuation of relative high levels of trade protection for the manufacturing sector.

Another point stressed by Navaretti and Venables (2013, p. 362) is that "(…) the infant industry argument is not applicable as MNCs do not need support to attain their own production possibility frontier. There are two alternative arguments for industrial policy towards such firms. One we refer to as location, deriving from possible benefits of having an MNC locate a project in our country rather than elsewhere. (…) The other is ownership; what are the effects of changing ownership of existing activities, and should policy seek to influence the ownership (or control) of activity in a country?". Moreover, the authors consider the case where multinationals can be firms with domestic ownership that are able to decide their location among any part of the world. This concept could be applied, for example, to cases where multinationals face the decision of abandoning their current location, either to relocate anywhere or to simply shutdown. But location decisions can imply technological spillovers, including under the form of learning-by-doing – one of the infant industry arguments for protection. Therefore, the industry where the multinationals operate within the domestic country, and their local employees, can still be viewed as potentially generating learning-by-doing, although the multinationals itself not.

Are the new technologies contributing to the technology convergence among countries? how and why?

How are digital technologies and industry 4.0 affects the channels between trade and competitiveness?

a) One argument is that new technologies are reducing entry barriers and also facilitating catching up, as the access to technology becomes easier. In this world of mobile factors of production and easier availability of goods and services suppliers, the business environment and institutions gain importance as reasons for location decisions: a bad business environment can be detrimental especially to start-ups, without access to lobby and very dependent on the availability of fast transactions and the rule of law. (Delloite and Singularity, 2018).

b) Moreover, as the technology frontier is moving faster, catching up based on protection is riskier, as the time needed to learn domestically can be offset by the speed of technology in foreign markets. (Lee, 2012; Delloite and Singularity, 2018)

c) The converse argument is that the new technologies are making innovation and production ever more concentrated on already established regions. Protection is then necessary to counterbalance this movement, although it is often concealed that innovation efforts should ideally be partnered or helped by regional trade agreements, if a country is not large enough to provide the required scale.

The main debate emerging from those considerations is if innovation spills over freely across borders and at long distances.

The most recent wave of new technologies that are heavily affecting production structures and demand around the world has been called by names such as "exponential technologies" and "digital technologies", and the industries employing these are called "industry 4.0", as it is deemed the "fourth industrial revolution". These new technologies, when applied to manufacturing, are usually centred around ways to automate processes including the ones that require reasoning and decision-making. Another way to characterize these new technologies is its unprecedented speed – how fast they evolve and how fast they create and alter entire economic sectors. This disruptive trait puts innovation and technology adoption capabilities at the forefront of any industrial strategy (Delloite and Singularity, 2018).

Although automation and IT technologies have been around for some decades, there are some differences in the current paradigm shifting: new and bigger data sources; business models as platforms; and the growing use of artificial intelligence (Sturgeon, 2017). The author concludes that it is difficult to forecast the consequences in terms of future location of investments and facilities among countries and regions, and identifies some contradictory trends: he recalls that thanks to 3-D printing and flexible machinery, the production of parts and final goods could be done with less scale, closer to the final demand. However, he also recalls that given the high initial costs of some technologies and data advantages, and the possibility of achieving great product variety within production lines, final goods production could be concentrated in clusters with huge scale capacities, taking advantage of economies of agglomeration within its value chains, and being able to reach consumers worldwide at lower costs. This is especially relevant for some frontier R&D: R&D investment can take many years before it generates some innovation that becomes a technology ready to be applied. This makes investment in R&D more costly and risky, thus increasing the need for a more collaborative investment in R&D, putting together public and private players, domestic and foreigners, especially if these are located in global centres of knowledge. The partnerships or contacts with firms and institutions located in the most important centres for innovation are becoming even more important. Delloite and Singularity (2018). A last identified possibility is that location of production will not be changed by the new technologies, and the main outcomes will be a growth in productivity and quality, and a fall in the demand for labour (Sturgeon, 2017). Sturgeon (2017) suggests that the value-added could still be concentrated, but with very few jobs, in few worldwide centres, while production using these central innovations and secondary innovations could be more easily widespread.

Some new technologies are allowing for a reduction in the demand for less skilled labour, and allowing the creation of new products with much less use of engineering skills or heavy machinery (Sturgeon, 2017). This trend can be specially damaging for development strategies based on more traditional manufacturing sectors that are intensive in heavy machinery and labour applied to repetitive tasks – such as the automotive sector, for example. Thus, it is advisable, in a developing perspective, “to create an environment that attracts and retains top performing manufacturing companies, as manufacturing has the highest multiplier rate across industries" Delloite and Singularity (2018).

Thus, relying on more traditional or low-skill labour-intensive technologies seems not to be a viable path to development, for two main reasons, found in the literature:

a) If the speed of learning and technological upgrading that an industry is able to show is lower than the speed of technological progress in the frontier, the catch up will not happen. Thus, time is crucial. For example, as cited in Lee (2012), "(…) Howitt and Mayer-Foulkes (2005) proposed a Schumpeterian model of growth divergence focusing on the possibility of ever weakening potential for technology transfer, in which technologically backward countries face increasingly eroding absorptive capacity (due to increasingly ineffective technology investments) for tapping into global technology frontier, as the world's technological frontier advances". (Lee, 2012, p. 112). Thus, it may be that the difficulties for productivity growth are higher when all the sectors – including especially the intermediate goods – are protected.

CNI (2018) states that the current pace of technology related to industry 4.0 increases the need for more innovation, to try catching up with the technological frontier. This is then a perception, from the firms, that the new technologies have the potential to widen the gap, if there are not enough capabilities to innovate and/or assimilate the foreign technologies.

b) Lower wages have been a comparative advantage of developing countries and one of the main drivers of FDI during their industrialization processes. However, production costs are becoming less dependent on wages and more dependent on the scale, availability of skilled labour, good institutions and business environment. These factors could even explain why Asian developing countries performed better than Latin American ones, from the 80s, but the novelty is that these same factors are gaining even more importance, thanks to the digital revolution, automation, and importance of new ideas and specialized services in generating new avenues for value added in manufacturing. The fact that these services, including design, marketing, and research can increasingly be exported (Hallward-Driemeier and Nayyar, 2017) contributes to their importance as sources of income and to the importance of scale in suppling it competitively.

Industrial policies for R&D are still found in many developed countries. In fact, this may be considered a resurrection triggered mainly by the financial crisis of 2008 and the consequent need for government support both in terms of monetary and fiscal policies. Some developed countries have clear national strategies for boosting digital technologies and industry 4.0, as, for exempla, the USA, Germany, and, more recently, the UK. Developing countries are much less able to follow such strategies with the necessary amount of R&D expenditures, apart from China, which is set to compete with the leading developed countries in R&D. Within this context, the Chinese Government launched the “Made in China 2025” initiative, to increase the local content of Chinese manufacturing to 70% by 2025. The policy includes subsidies to produce specific products and for domestic firms; the use of government purchases to induce domestic production especially in information technologies; and the acquisition of foreign firms and technologies. Delloite and Singularity (2018)

Sturgeon (2017) recalls that, although industrial policies are usually based on the idea of complementarities between technology/innovation and production activities, in some industries, such as motor vehicles and electronics, for examples, the value chain works with geographically separated production and innovation clusters. He then asks a second question: if co-location will prevail under the new technologies, which part of the value chain will move? The R&D or the production? As cited by the author, there is some evidence of a coming back of some industries to developed countries, either because of automation (and thus less need for cheaper labour), or because there is a more active “industrial policy” from developed countries, or even because of new technological requirements in production. However, this movement is still very small and, according to the author, does not alter the pattern of R&D and production located in countries with cheaper labour. All in all, the author concludes that the new technologies are allowing for a further fragmentation in the production process, as R&D could be embodied in other easily transported products or services, and design services, for example, could be easily decentralized done at lower costs. This means that there is less need for co-location of R&D and production activities, and that maybe the result will depend on the interaction between strategic firm-specific decisions and the governmental policies in place.

The view that production is becoming a lower value-added activity, in contrast with R&D and some manufacturing-related services, is known in the literature as the "smiling curve"[62], confirmed initially by Linden et al (2009), who, according to Sturgeon (2017) used the example of the Apple iPhone and calculated that "China's value added to a US $600 iPhone 4 (mainly assembly and packaging) was only US $6.54, about 1% of the retail price".

Sturgeon (2017) also concludes for three scenarios regarding the role of developing countries in the new manufacturing and R&D landscape: a) routine tasks would be "re-shored or even eliminated by advanced manufacturing and automation"; b) developing countries will be able to use the new technologies to gain competitiveness and upgrade their industries; c) the landscape does not change too much, as there are counteracting forces playing around.

Consolidation in the automotive industry was driven by a search for scale (at firm level) and the need to heavily invest in R&D (Natsuda, Otsuka and Thoburn, 2015). But while demand and production have been moving from Europe and North America to Latin America and Asia – a shift driven by production costs and/or domestic demand growth (Natsuda, Otsuka and Thoburn, 2015), R&D is becoming more concentrated, specifically regarding the centres of global platform innovation, in a movement driven by a winner-takes-all type of competition (Sturgeon, 2017).

Taking specifically the average scale, it is clear that Asian countries achieved this through exporting, even when they had a reasonable domestic market. However, recent protectionist policies around the world seems to indicate that export-led growth strategies would be more difficult to attain.

[62] The smile curve: value added is higher in R&D and design, lower in production, and higher again in services and marketing.

Observing a list of the potential future drivers of competitiveness, elaborated by Delloite and Singularity (2018), we note that availability of talents is the single most important factor. Trying to group these factors, we could say that the following groups are important for competitiveness under the new technology paradigm: 1 – skills/talent/education; 2 – costs and productivity; 3 – business environment and institutions, including the ones directly linked to innovation. Although the single main driver to improve a country's environment for innovation would be the availability of talented and high skilled people, improving the business environment and the access to foreign technology would certainly help: a) better institutions and business environment can promote start-ups and encourage innovation; can provide a safer and more pro-growth environment for these firms; and can attract global talents in search for a good place to live and develop ideas; b) access to foreign technology increases the potential combinations of cost-quality-innovation in production, thus allowing for either cost reductions, productivity gains, or simply innovation, with impacts in the entire domestic value-chain.

In terms of geographic distribution, by 2018 R&D investments remains heavily concentrated in the United States, with China growing rapidly and set to surpass the US very soon. However, if we look at the sources of R&D investments, most of it comes from private manufacturing firms – thus an indication that attract and maintain a manufacturing base is still important for R&D generation (Delloite and Singularity, 2018). The R&D investments worldwide is concentrated in large multinational private companies, with the automotive sector being among the top contributors, together with the technology sector, the pharmaceutical sector, and the electronic goods sector.

As suggested in Delloite and Singularity (2018), "manufacturers should plug into an innovation network and create bilateral or multilateral relationships that (…) serve as a feeder system for ideas/building blocks for the iterative development of breakthrough innovation" (page 24). This statement resulted from the acknowledgement that technology is evolving ever faster.

FORD (2016) announced that Ford Motors plan to turn themselves into an "auto and a mobility company". This means investing not only in trends like electrical and hybrid cars, but also on autonomous-driving vehicles and vehicle-sharing platforms. The company also recognises that the industry faces huge excess capacity, mainly in Europe and Asia. Finally, the report states that patents are an important asset for the industry, as technological innovation is still actively pursued.

Here is a list of the most important new technologies applicable to a 4.0 automotive industry, based on Delloite and Singularity (2018):

- 3D printing, eliminating the need of physical modelling and allowing the reproduction of parts at very small scale and at a much faster speed. It is starting to be used to produce prototypes and autoparts;
- Advanced analytics: data analysis and intelligence, based on methods such as text and image recognition, machine learning and etc, that can be used to automate supply chains, for example;
- New advanced materials, that can be lighter, stronger, or made with new chemical or biological elements, and that are changing the material composition of vehicles;
- Advanced robotics;
- Artificial intelligence (AI), that have been used to allow a computer vision in semi-autonomous vehicles;
- Biotechnology: any technology that uses biological organisms or its by-products. An example of future use are synthetic biological cars that repair themselves;
- Blockchain: a technology that allows the recording of transactions (information) within a database where information flows without any centralized control. An example of use is within the transfer of personal data in car sharing schemes;
- Designing and virtual prototyping using computer simulations. Example of current use: 3D CAD for designing in auto manufacturers;
- Energy storage technologies: more efficient energy storage capabilities, including new types of batteries, technologies to store compressed air and other types of energy. Example of current use: storage for electric vehicle charging;
- High performance Computing (HPC), allowing for highly complex simulation models of virtual crash testing and wear and tear of materials and parts;

- Interface of Things - technologies that allow the exploration of virtual or augmented realities; and wearables that can be used at assembly plants, for example;
- Internet of Things (IoT): technologies that interconnect machines, people and the environment, using sensors and advanced software, and allows machines to operate with different degrees of autonomy. Example of current use: automatic accident notification.

The reviewed literature provides some evidence that the speed of technological changes and innovation is accelerating and that value-added in labour-intensive manufacturing is decreasing. The future patterns for location of manufacturing and for the type of technological spillovers are less clear.

2.6 The potential channels

Drawing on the material from the previous sections of this chapter, we suggest a taxonomy to build a framework containing the most relevant relationships and trade-offs for the debate between trade liberalization and trade protection.

Potential channels

Group 1: Scale-related channels. Here there is the discussion if the best strategy is to have fewer, better and more specialized firms or sectors, or to have a more diversified economy, even with firms initially not competitive at international levels. It includes the effects of market size on R&D.

Group 2: Competition-related channels. The debate includes discussions about how competition impacts innovation, and comprises efforts to make better, and capacity to make better, at firm-level. Within this group are changes in productivity arising from firm-level efforts (productivity arising from changes in X-inefficiencies - given competition pressures to reduce costs -, and innovation resulting from competitive pressures); productivity arising from changes in the barriers to entry and exit, affecting average productivity; and productivity arising from the effects on static and dynamic allocative efficiency (resources going to where there is more comparative advantage, either static or dynamic), resulting from protection levels.

Group 3: Resource allocation and access to technology.
Effects on innovation and technology adoption given the access to technology embodied into imported inputs and machinery, and effects on the quality and cost of production, given the access to inputs and machinery at international price and quality; and effects on innovation and technology adoption given the access to technology through exposure to foreign markets and technology (exports, inward and outward FDI, for example).

Group 4: Institutions and business environment channels. The debate discusses how protection levels and the business environment are related, and how one affects the other. Less protection gives incentives for firms to lobby for better institutions and better business environment, as this become relatively more important for their competitiveness, as they cannot rely on protection to survive. Similarly, a good business environment would give better competitiveness conditions, and thus less need for protection. On the other hand, a bad business environment and bad institutions overall generate the need for protection. Moreover, a highly protected industry would prefer to keep this status quo than to improve the overall business environment, as the protected firms would be able to lobby for special treatments allowing them to survive within the bad business environment while making difficult for the competition to enter or to remain in the market.

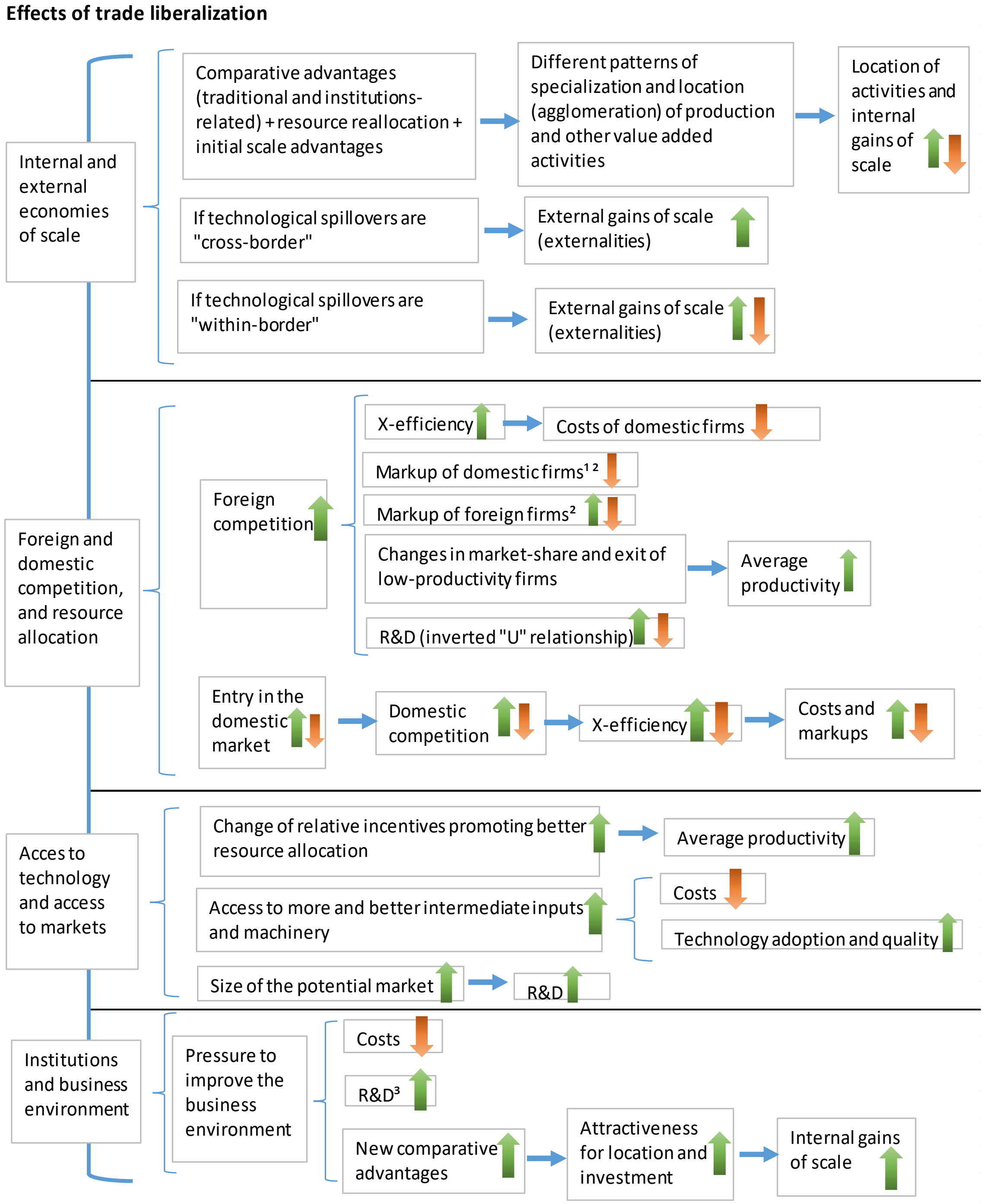
The thesis analyses these channels using the Brazilian automotive sector as a case study. However, our research also analyses how the new digital economy and the emergence of the so-called industry 4.0[63] could alter the results from the channel analysis. One argument is that new technologies are reducing entry barriers and also facilitating the catching up, as the access to technology becomes easier. In this world

[63] Industry 4.0 refers to industries under a so-called fourth industrial revolution, characterized by more automation of the manufacturing process, including the use of artificial intelligence, and that can present other aspects such as customization and service-orientation, for example.

of mobile factors of production and easier availability of goods and services suppliers, the business environment and institutions gain importance as reasons for location decisions: a bad business environment can be detrimental especially to start-ups, without access to lobby and very dependent on the availability of fast transactions and the rule of law. Moreover, less protection would make easier for domestic firms to access these available resources, worldwide.

Moreover, as the technology frontier is moving faster, there is no room for any tentative of catching up based on import-substitution strategies and infant industries policies aiming to give time for a domestic learning-by-doing. The converse argument is that the new technologies are making innovation and production ever more concentrated on already established regions. Protection is then necessary to counterbalance this movement, although it is often concealed that innovation efforts should ideally be partnered or helped by regional trade agreements, if a country is not large enough to provide the required scale.

Figure 6 – Channels for effects of trade liberalization



Notes:

¹If the domestic firms were previously less competitive than the foreign firms. If they had similar competitiveness, a reduction in the domestic mark-up could be compensated by an increase in the mark-up for the new exports of the domestic firm, symmetrically to the mark-up of foreign firms.

²Assuming imperfect competition.

³Potential permanent/long-term effect.

2.7 CONCLUSION

In this chapter we reviewed the theoretical background that could explain when and how trade protection (or trade liberalization) can enhance welfare. An important insight is that different assumptions and different timescales can drastically change the results. These remarks are the source of most antagonist positions in the broad debate on trade liberalization. Overall, the conflict in the literature regarding protection is between those who: a) advocate that lower protection stops the achievement of dynamic efficiency (through Marshallian economies of scale and learning-by doing), thus generating dynamic costs of losing domestic sectors; and b) advocate that lower protection promotes the achievement of dynamic efficiency (through Marshallian economies of scale), as it promotes innovation efforts (because of “escape-competition effects”); and higher productivity (given the gains in allocative efficiency, specialization and access to better inputs).

Concisely, there are two conflicting potential outcomes of protection regarding the achievement of scale gains and learning by doing:

a) on one hand, protection may promote internal and external scale gains and innovation efforts in the protected final goods sector;

b) on the other hand, protection can be damaging through increasing costs and decreasing quality/innovation in intermediate goods, lower participation in Global Value Chains, consequently deterring internal and external scale gains and innovation efforts in the protected final goods sector, and also in the intermediate sector.

Since the emergence of monopolistic competition trade models, scale of production is important to define competitiveness, as well traditional comparative advantages, but only recently the literature has acknowledged that institutions – including business environment aspects – can even affect comparative advantages. Institutions can affect both scale and comparative advantages, as in Rodrik (1988) and Nunn and Trefler (2014). Moreover, some endogenous growth models can explain economic growth as a result of higher domestic scale of production – and this is not equal country size: the scale can be fostered either by more domestic integration -thus including a better business environment – and by participation in global value chains, including using regional trade agreements, for example. Therefore, all three aspects – scale, business environment, and comparative advantages - are important and mutually reinforcing.

Both trade protection and trade liberalization can promote domestic external economies of scale: the resulting domestic production depends on the relative competitiveness and internal scale achieved by the firm under a protected and under a liberalized environment. In this sense, the ability to assess cheaper and better production inputs is of particular importance. Protection can deter domestic external economies of scale if domestic firms start to use less advanced or more costly inputs. These outcomes can be made even worse if one includes business environment restraints. Therefore, a relatively widespread protection of the domestic market, that includes most of the inputs necessary for the final goods, together with a bad business environment, can drive the overall competitiveness and domestic scale downwards through time, making catching up ever more difficult, and a vicious circle more likely.

Moreover, if the speed of learning and technological upgrading that an industry is able to show is lower than the speed of technological progress in the frontier, the catch up will not happen. Thus, time is crucial. For example, as cited in Lee (2012), "(…) Howitt and Mayer-Foulkes (2005) proposed a Schumpeterian model of growth divergence focusing on the possibility of ever weakening potential for technology transfer, in which technologically backward countries face increasingly eroding absorptive capacity (due to increasingly ineffective technology investments) for tapping into global technology frontier, as the world's technological frontier advances". (Lee, 2012, p. 112). This could be read as a warning for those who wish a widespread and deep protection policy: the difficulties for productivity growth are higher when all the sectors – including especially the intermediate goods – are protected.

To shed light on these relationships we proposed a framework to explain the potential channels linking trade policy to industrial competitiveness.

CHAPTER 3 – METHODOLOGY

3.1 RESEARCH STRATEGY

We follow a "theory building" research strategy, thus an inductive approach, to generate insights to answer our research questions. Our methodology is an exploratory and observational case study: exploratory because we intend to gain insights on the relationships among the variables under study, and observational because instead of using experimental controls to manipulate our sample, we draw inferences from the sample based on data analysis without a treated and a control group. For this, we use a mixed methods strategy, combining quantitative and qualitative methods of analysis. A methodology needs to link the theories we use to the methods we chose to analyse our data, and, as our study is inductive, also to later link the data results to an explanation or theory. This is done in chapter 7, when we triangulate the partial results of each chapter and concludes. Our research then draws inferences from the case study (a detailed analysis) of a single industry, historically targeted by high import tariffs.

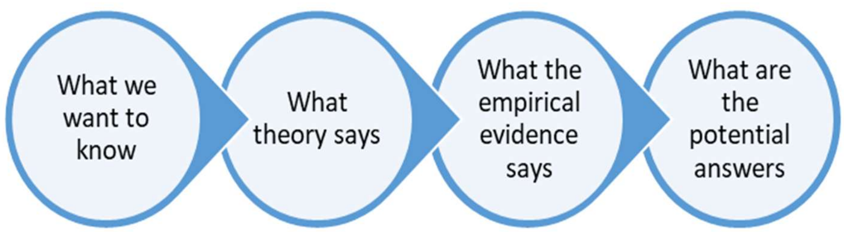
Our study starts with the identification of theories related to our research questions. These are described in the theoretical framework and provide a guidance for the following empirical literature review. This empirical literature review also contains qualitative and quantitative data to provide a context for the case study[64]. We then proceed to the interviews and its analysis, collecting relevant primary data and insights on the subject. The next phase is the gathering and analysis of several quantitative data, including primary and secondary ones, using different methods to analyse them. The choice of quantitative data was made following the results of the qualitative phase, and was also constrained by data availability, of course. Each one of these three data gathering chapters – empirical literature review, qualitative data and quantitative data – generates a set of partial insights and evidences. These are then analysed together

[64] For case studies literature see Yin (2012).

in another chapter, aimed to generate more insights resulting from the combination of the previously partial insights. The research questions are then answered in the light of such evidences.

In a nutshell, our exploratory sequential methodology addresses the existing theories and empirical literatures, and then gathers primary and secondary data to generate potential answers to our research questions. Figure 1 illustrates this broad strategy.

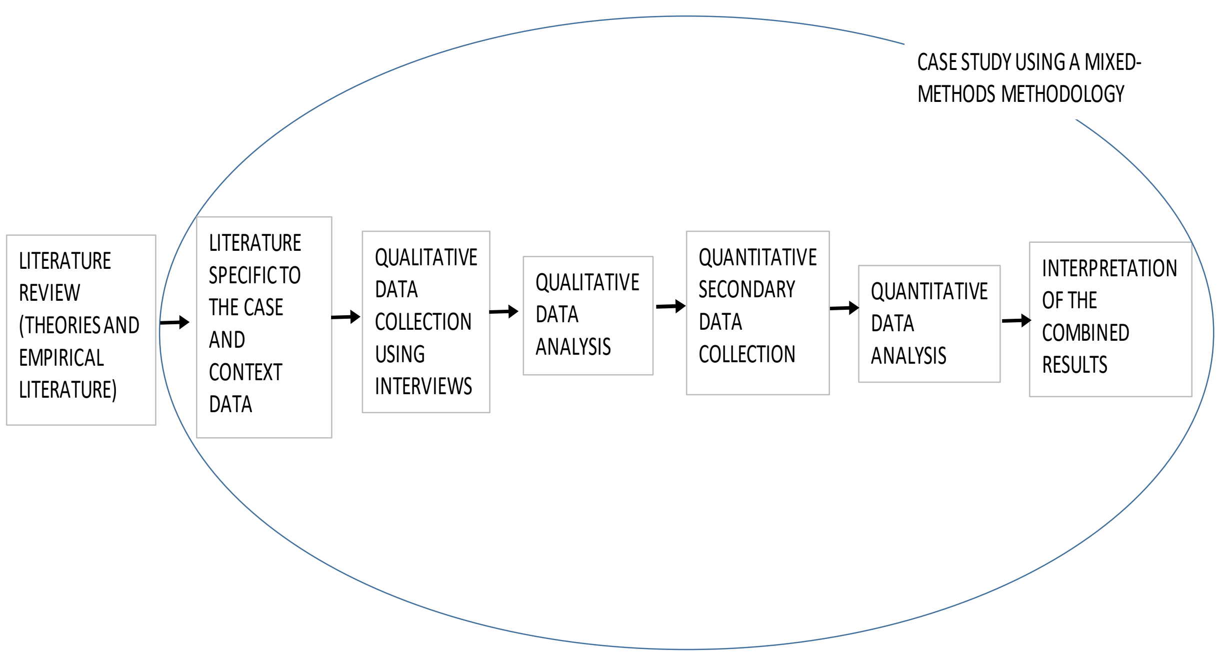
Figure 1 – An Exploratory Strategy



In this sense, we adopt an exploratory sequential mixed-methods design (or methodology), within a case-study framework. Within a mixed method, both quantitative and qualitative data are collected and analysed in a single study, aiming to improve the quality and comprehensiveness of the analysis through the triangulation of different types and sources of data. The Exploratory Sequential design is a type of sequential mixed methods that collects and analyses qualitative data before collecting and analysing quantitative data. This is different from the Explanatory Sequential Design, where the researcher initially collects and analyse quantitative data, and then use the qualitative data to help understand or explain the results of the first. In our choice – the Exploratory Design – qualitative data is used to gain initial insights that are then complemented by quantitative data analysis. These further insights can also take the form of a generalization of the data provided by the qualitative analysis. Following a classification provided by Creswell (2013), our design could be further classified as “taxonomy development model”. This is because our aim is to use qualitative data not only to gain insights related to our research questions, but also to guide us in the process of choosing the quantitative data we need. We will interpret the results of both strands – qualitative and quantitative – together, at a later stage.

As depicted in figure 2, our point of departure is the theoretical and empirical literature and then we move to different sources of data to contextualize and to provide detailed information on specific aspects of the case under study. The data collected through interviews is analysed using thematic analysis. For quantitative data collection we rely on several databases, therefore also using a bigger variety of analytical methods. The triangulation of results does not favour a priori any of the data sources, but follows a logical path where evidence is emphasized when coming from all sources or at least not contradicted by any source. However, if a piece of evidence is contradictory among the data results obtained, we further check the degree of confidence with each one of the data sources and put more emphasis on the results directly generated by our research (vis a vis eventual conflicts with the previous empirical literature review). The triangulated results will then be interpreted to answer our research questions.

Figure 2 – Research Design - A Variant of the Exploratory Sequential Mixed Methods



3.2 METHODS

The methods used in the analytical chapters (chapters 5 and 6) comprise the following:

Qualitative data

Semi-structured interviews - a survey with a purposive sample (elite interviews) will allow for primary qualitative data collection. Thematic analysis will be used to make sense of the data.

Sampling strategy

As depicted above, the primary qualitative data collection and analysis is based on semi-structured interviews with a purposive sample, and the results are broken down using the tools of thematic analysis. Our sample was selected to provide factual information on the subject under study but allowing different points of view. To make the sample as representative as possible, we decided to seek interviews with people from all subsets of the population related to or involved in the analysis of policies towards the automotive sector. The number of interviews was relatively small, as expected for elite interviews, but the depth and richness of information collected was very high. As a step to collect as much reliable information as possible, from different perspectives, to provide a comprehensive context and generate useful insights, the interviews were quite effective.

The main populations we studied are the automobile producers based in Brazil and the auto-part producers also based in Brazil. The former are mostly multinational companies that manufacture vehicles in Brazil. The latter are made up of different types of firms that supply the automakers with inputs and intermediate goods. These suppliers are usually divided into three categories: Tier 1 (suppliers of systems and complete parts, selling directly to the automakers); Tier 2 (suppliers of components, mainly to Tier 1 firms); and Tier 3 (suppliers of individual parts used by Tier 2 firms). Tier 1 firms are usually multinationals and work in collaboration with the automakers, even in the process of research and development. In this sense, we consider that Tier 1 firms share the interests of automakers. Tier 2 and Tier 3 are mainly medium and small domestic firms that usually compete with foreign suppliers. We also included an interview with representatives of Embraer, to provide important comparison insights between two sectors with very different competitive environment and tariff structure.

The population comprises around 500 Tier 2 and Tier 3 autopart firms associated to Sindipecas; 16 automakers producing cars and or light commercials (thus, not including assemblers that produce just trucks or buses) and 45 Tier 1 autopart firms.

Our purposive sample is made of “elite” interviews drawn from the population of firms and from academics, government officials and business associations with expertise in the sector and in the themes studied.

Questionnaire design

The face-to-face interviews include pre-defined open-ended questions. This approach has several benefits for our research: i) being pre-defined, it allows for comparison and a more effective analysis of the results; ii) being open-ended allows for a richer investigation and the collection of broader insights, in a more inductive fashion; iii) potentially provides explanations for why the phenomenon happens. On the other hand, it is more time consuming for the interviewees, for the interviewer and for the analysis.

On top of the time required to code and compare open-ended questions, the analysis of such interviews is also particularly challenging because: a) interviewees from different backgrounds tend to focus on specific topics; b) interviewees have different levels of knowledge and also of bias.

In the next section we will explain the procedures we took to minimize potential biases and also to make possible the comparison and analysis.

The Annex provides the questionnaires used as a basis for the interviews.

Treatment of confidentiality requirements and potential biases

Given the characteristics of the sample – purposive - anonymity is neither possible nor desirable. On the other hand, most of the respondents required confidentiality. This was expected, given that most of the interviewees have active roles in the industry under study, and thus could face a variety of sanctions if the insights or opinions they provided were disclosed.

The confidentiality was then granted through the consent form and is guaranteed in this section by expressions citing the broad area of activity of the individual. Furthermore, the aggregation in interviews categories is done in a way to have at least 2 individuals in each. This, added to the fact that no interviewee knows who else were interviewed, guarantees that the identification by triangulation is impossible. The only exception is for the interview with Embraer, in which case we grant confidentiality for the interviewee, as required, but not for the firm, as allowed by the interviewee. Furthermore, the identification of the firm in this case is not problematic as the firm is the main aeronautical producer in Brazil and it is being used only as a benchmark for comparison, with only publicly available data being used and no confidential or strategic information being discussed.

There is always the risk of potential biases from interviewees seeking to defend their interests. This is especially true when we are dealing with representatives of private firms that are asked to talk about factors affecting their competitiveness: they probably choose to focus on aspects that they want to be changed, or that are the responsibility of third parties. Moreover, the fact that the researcher is a previous policymaker can bring further questions related to the researcher positionality.

To alleviate the first issue, we rely on the diversity of interviewees, and on the duration of each interview, with enough time to cover all aspects involved, and not only those the interviews wish to highlight. To alleviate the second issue, the researcher explained that he was a policymaker in the past, but that was currently engaged in the Doctorate study and would probably pursuit a career in academia. Moreover, the researcher was based in the UK, with no contact with Brazilian officials currently in charge of the policies for the sector.

Interviews information (dates, places, duration, origins of interviewees)

The first set of interviews had a total of 14 people interviewed in 10 different interviews, face to face, with an average duration of 3 hours (4 hours maximum and 1,5 hours minimum), totalling around 26 hours of interviews. The interviews were conducted in Sao Paulo and in Brasilia, Brazil, in May 2017.

The second set of interviews had a total of 15 people interviewed in 8 different interviews, face to face and using videoconference, with an average duration of 2 hours (3 hours maximum and 1 hour minimum), totalling around 16 hours of interviews. The interviews were conducted in Sao Paulo and in Brasilia, Brazil, during the last week of November and the first week of December 2017.

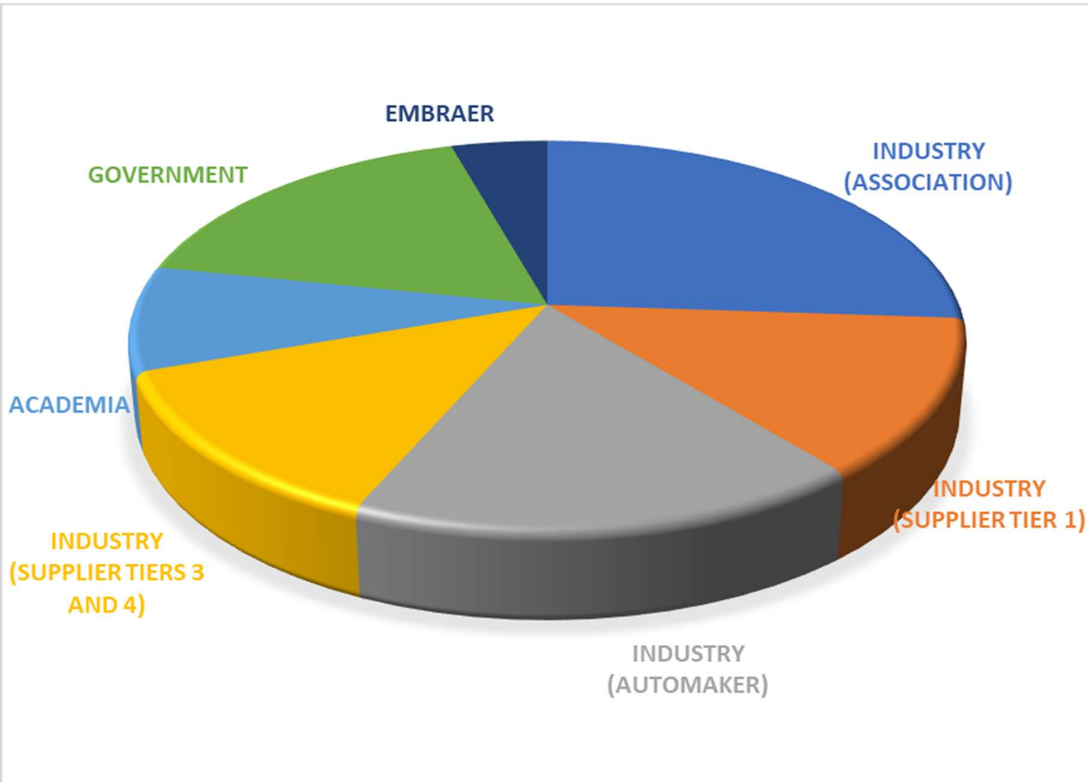
The third and last set of interviews was conducted from April to June 2018, through videoconferences, in Brasilia and in the United Kingdom. This round had 5 interviews and included two automakers, one association, one lower-tier supplier, and one firm from the aeronautical sector.

Table 1 and figure 3 shows the distribution of participants among the seven categories we labelled: Academics; Government officials/policymakers; Industry representatives from associations; automakers; suppliers Tier 1; suppliers lower Tier; and Embraer.

Table 1 - Number of interviews, involving one or more people in each, with specialists in the Brazilian automotive sector or the Brazilian industrial sectors.

NUMBER OF INTERVIEWS, INVOLVING ONE OR MORE PEOPLE IN EACH, WITH SPECIALISTS		
SECTOR	**INTERVIEWS**	**PARTICIPATION**
INDUSTRY (ASSOCIATION)	6	26.09%
INDUSTRY (SUPPLIER TIER 1)	3	13.04%
INDUSTRY (AUTOMAKER)	4	17.39%
INDUSTRY (SUPPLIER TIERS 3 AND 4)	3	13.04%
ACADEMIA	2	8.70%
GOVERNMENT	4	17.39%
EMBRAER	1	4.35%
TOTAL	23	100.00%

Figure 3 – Distribution of interviews per category.



List of interviewees:

Among the government officials interviewed we have:

- A former Director of the department for automotive industries in the Ministry of Trade and Industry;
- A Director of the department for automotive industries in the Ministry of Trade and Industry;
- A manager at ABDI, specialized in the automotive sector and in innovation;
- A senior official in the Ministry of Finance, overlooking the industrial sector and competitiveness issues in general.

Among the representatives of industrial associations, we have:

- A manager at CNI overlooking trade-related issues;
- A manager at CNI overlooking productivity and policy-related issues;
- The president of Sindipecas;
- A manager at Sindipecas;
- A former senior economist at Sindipecas;
- An executive at ABEIFA.

Among the Suppliers we have:

- Two low tier suppliers;
- A tier 2/3 supplier specialized in hardware and rubber;
- Two tier 1 suppliers with domestic capital;
- A tier 1 supplier with foreign capital.

Among the automakers we have:

- Three automakers with high scale of production in Brazil;
- One automaker with small scale in Brazil.

Among the academics we have:

- One academic specialized in innovation and competitiveness, and with vast experience in senior governmental positions;

- One academic specialized in the automotive sector, and with experience in international organizations.

We also had a representative from the aeronautical sector (Embraer).

Analysis of interviews - establishing codes and categories / themes / sub questions.

We use thematic analysis as a method to make sense of the data and information obtained from the interviews.

To properly analyse the results, we first need to conceptualize the data. This will allow us to make sense of unstructured data (qualitative data from interview transcripts), to generate new knowledge. To make the information gathered tractable we then need to clean up the transcripts, eliminating repetitive statements and unnecessary wording, and organizing the flow of ideas.

Sequentially, we coded the cleaned transcripts, using colours to identify similar phrases and words within the text. Once this process was done, we identified the topics and subjects present in each interview transcript. Sequentially, we created themes and allocate the coded excerpts from each interview into a related theme. The strategy to create these themes was straightforward: we grouped the topics identified in each transcript into topics related either to the questions of the questionnaires and to the answers to open-ended questions.

In other words, each coded information or data extracted from the interview transcripts is allocated into one or more than one theme/category. Any specific information or data can be allocated into more than one theme/category: this is a consequence of the complexity of causes and effects observed and proceeding this way we preserve the richness of information and allow for more insightful analysis.

A third step was to group the interviewees into one of the six categories (Government, Industry – automakers, …) and to label each one with a sequential number, in order to grant confidentiality and at the same time be able to discuss the different points of view according to the origin (category) of each interviewee.

After carefully classifying each interviewee and having coded and classified each part of their responses we were able to build a more tractable matrix of results. In the fourth step we extracted partial results for each pre-defined theme. In this process we identified consensus and differences, highlighting how these differences were distributed among the main categories of interviewees. We also highlighted any information that provides an insight not mentioned by others, but that was not contradicted. This allowed us to broad our perspective and to potentially follow other lines of investigation, eventually helping to make sense of the other results.

The themes were the following:

A - EFFECTS OF BUSINESS ENVIRONMENT ON COMPETITIVENESS AND ITS RELATION TO THE PROTECTION LEVELS.
B1 - EFFECTS OF PROTECTION ON THE ACCESS TO TECHNOLOGY AND ADOPTION CAPACITY, INVESTMENTS, COMPETITION LEVELS AND MARKUP
B2 - IS PROTECTION EXCESSIVE? DO FIRMS WANT MORE OR LESS? HOW TO LIBERALIZE?
C - WHY ARE THERE TOO MANY SMALL AND INEFFICIENT FIRMS.
D - REGULATION AND INDUSTRIAL POLICY; INVESTMENTS IN R&D, AND THE EFFECTS OF INOVAR-AUTO
E – SPECIALIZATION, EXPORT-ORIENTATION AND SCALE.
F - HOW NEW TECHNOLOGIES WILL AFFECT THESE FINDINGS? WHAT NEEDS TO BE DONE TO CATCHUP IN THIS ENVIRONMENT? IS THERE A RATIONALE FOR A "NATIONAL CAR"? WHICH TECHNOLOGIES TO INVEST IN?
G - INVESTMENT DECISIONS OF MULTINATIONAL FIRMS.

The interviews results were then regrouped into themes.

Quantitative data

The methods for our quantitative analysis are both of descriptive and inferential nature. The descriptive part presents and describes the sample data, obtaining key statistics. This basically summarize data, allowing the researcher to compare it with other pieces of evidence and to draw some conclusions. The other set of methods we use - the inferential statistics - reach conclusions about populations based on sample analysis. This can take the forms of a regression estimation, a correlation analysis, or a hypothesis testing. In our case we apply both tests of associations: correlation analysis; and regression analysis.

Analysis of correlations: to measure the strength and direction of the relationships between variables. Under this analysis it's not possible to distinguish causal effects and therefore it is not designed to test a hypothesis, but only to gain further insights. We will apply the Pearson correlation coefficient to a series of variables, to measure the relationship between pairs of variables.

Regressions: it can be viewed as a correlation among variables that, when using multiple variables, can provide a better understanding of the relationships among those, taking into consideration the interactions and shared effects among the same variables, and also given the addition of other explanatory variables.
In our regression we still cannot state causality, as this would only be possible under a randomized controlled trial.

The quantitative exercises on chapter 6 are then the following:

I – International Comparison of Toyota Corolla prices, using exchange rate adjustments, and testing scale, specialization, trade barriers, taxation and business environment measures as potential explanatory variables;
II - Evolution of real prices of cars from 1989 to 2019 and potential explanations;
III – Industrial organization background, an analysis of the evolution of domestic competition and market-power, and inferences about the interactions among exchange rate movements, imports, scale, concentration and prices;

IV – Comparison of cost structures and sensitivity analysis: a) comparison of the average cost structure for automakers in Brazil in 2017 versus the average cost structure of other manufacturing sectors (agricultural machines, motorcycle, aeronautical) in Brazil in 2017; b) sensitivity analysis – how performance and competitiveness are affected by changes in variables related to: i) trade barriers; ii) business environment; iii) scale of production; iv) specialization and labour productivity. This analysis can clarify the effects of inputs costs and also of “custo-Brasil” on different industrial sectors, thus allowing us to estimate its relative importance;

V – Estimation of changes in Total Factor Productivity for the Brazilian automotive sector from 1996 to 2017. Sectoral level total factor productivity (TFP) estimates, based on a Cobb-Douglas production function such as $Y_i = A_i K_i^{\alpha k} L_i^{\alpha l}$ using monetary inputs and outputs. We are then assuming that prices reflect marginal costs.

VI - Aggregated longitudinal (time-series) regressions. Simple or multilinear regressions, using aggregated secondary data.

CHAPTER 4 – THE AUTOMOTIVE SECTOR IN THE WORLD AND IN BRAZIL: EVOLUTION AND THE CONTEXT WITHIN THE BRAZILIAN INDUSTRIALIZATION PROCESS

This chapter will bring data from the literature and other secondary sources to better characterize the Brazilian automotive sector, comparing it with other Brazilian industries and with other countries. Moreover, it provides an overview of the industrial policies that affected the sector, in Brazil, with an emphasis on the Inovar-Auto.

4.1 CURRENT CONTEXT

This section brings a broader layer of context for the case study developed in this thesis. It comprises narratives found in the literature about why and how the automotive industry evolved in Brazil, and a brief account the overall industrialization process in Brazil, and also the growth of the automotive sector worldwide.

Brazil has a very distinguished "industrial mass" among developing countries. This was created through decades of import substitution strategies and high levels of protection that last up to the trade liberalization or early 1990s. Despite the reduction of tariffs and the elimination of most quantitative limits, the Brazilian Industry continued to be among the most protected in the world.

The vehicle production capacity of automakers associated to Anfavea, in 2017, was of 5,05 million per year, although in that year the total vehicle production was 2,7 million units. There were 16 car manufacturers, 9 light commercial manufacturers, 10 truck manufacturers and 9 buses manufacturers, all with production distributed through 65 industrial plants (source: Anfavea website). An interesting characteristic of the Brazilian vehicle production is the dominance of flex fuel engines: in 2017, vehicles able to receive both alcohol and petrol were around 63% of the production.

There were also 446 producers associated to Sindipecas in 2017. Table 1 shows that the autopart sector has been hit by the economic crisis after 2014. Moreover, between 60% and 70% of its sales is for automakers, with the remaining sources of turnover coming from spare parts, exports, and sales to other autopart producers.

Table 1 – the Brazilian autopart sector

Brazilian Autoparts Sector							
	2012	2013	2014	2015	2016	2017	2018 (projection)
Employment (thousands)	218.6	220	204.8	172.4	162.2	164.6	174.5
Nominal Turnover (R$ bi)	81.7	87.6	80.1	71.3	69.8	86.6	98.9
Nominal Turnover (US$ bi)	41.7	40.6	34.1	21.3	20.1	27.1	26.9
Total investments (R$ bi)	4.08	4.53	2.4	1.9	1.57	1.85	2.47
Total investments (US$ bi)	1.89	1.93	1.02	0.57	0.45	0.58	0.67
Exports (US$ bi FOB)	10.58	9.85	8.34	7.56	6.56	7.41	8.26
Imports (US$ bi FOB)	16.69	19.75	17.34	13.15	11.82	12.75	14.54
Trade Balance (US$ bi FOB)	-6.11	-9.89	-9.00	-5.60	-5.26	-5.34	-6.28
Annual Inflation (IGPM)	7.80%	5.50%	3.70%	10.50%	7.20%	-0.50%	8.20%
R$/US$ (*)	1.96	2.16	2.35	3.35	3.47	3.20	3.68
(*) average buying exchange rate							
Source: Sindipecas. "Desempenho da Industria Brasileira de Autopecas". www.sindipecas.org.br							
Sources of Turnover - per segment (%)							
	2012	2013	2014	2015	2016	2017	2018 (projection)
Automaker	69.3	70.4	67.6	60.8	61.7	62.4	64.4
Spare/replacement	14.7	14.5	16.7	18.8	18.2	18	17.2
Exports	8.6	8.3	10.3	14.7	14.2	14	13.2
Intrasectoral	7.4	6.8	5.4	5.7	5.9	5.6	5.2
Source: Sindipecas. "Desempenho da Industria Brasileira de Autopecas". Www.sindipecas.org.br							

Table 2 presents an international comparison of Brazilian cars and light commercial production. The year of 2017 marked a relative rebound for the country, from the very bottom period of 2014-2016, but still far from the golden period that culminated in 2013. Brazil was then the 9th biggest producer in 2017.

Table 2 – Vehicle production worldwide- 2017

Country	Cars	Commercial vehicles	Total	% change from previous year
China	24,806,687	4,208,747	29,015,434	3.19%
USA	3,033,216	8,156,769	11,189,985	-8.13%
Japan	8,347,836	1,345,910	9,693,746	5.31%
Germany	5,645,581	0	5,645,581	-1.76%
India	3,952,550	830,346	4,782,896	5.83%
South Korea	3,735,399	379,514	4,114,913	-2.69%
Mexico	1,900,029	2,168,386	4,068,415	13.00%
Spain	2,291,492	556,843	2,848,335	-1.30%
Brazil	2,269,468	430,204	2,699,672	25.20%
France	1,748,000	479,000	2,227,000	6.54%
Canada	749,458	1,450,331	2,199,789	-7.21%
Thailand	818,440	1,170,383	1,988,823	2.28%
UK	1,671,166	78,219	1,749,385	-3.70%
Turkey	1,142,906	552,825	1,695,731	14.12%
Russia	1,348,029	203,264	1,551,293	19.01%
Iran	1,418,550	96,846	1,515,396	18.19%
Czech Rep.	1,413,881	6,112	1,419,993	0.00%
Indonesia	982,356	234,259	1,216,615	3.30%
Italy	742,642	399,568	1,142,210	3.53%
Slovakia	1,001,520	0	1,001,520	-3.70%
Others	536,725	221,947	758,672	16%
Poland	514,700	175,029	689,729	1.16%
South Africa	321,358	268,593	589,951	-1.51%
Hungary	502,000	3,400	505,400	-4.01%
Argentina	203,700	268,458	472,158	-0.13%

Source: http://www.oica.net/category/production-statistics/2017-statistics/

The behaviour of vehicle production has its own idiosyncrasies but is also related to the overall trends in manufacturing around the world. Although car manufacturing has been moving towards countries with relative better demand potential – such as the main developing countries, overall manufacturing has been increasingly concentrated in Asian countries, as can be seen from table 3. Only big countries in Asia are increasing their manufacturing value-added. Brazil`s is declining, in line with most countries excepting Asian ones: China, Korea, India and Indonesia.

Table 3 – Share in world manufacture value-added

Shares in World Manufacturing Value-Added (1)				
Country/Economy	**2005**	**2010**	**2015**	**Trend**
China	11.75	18.69	23.84	
United States of America	20.43	17.77	16.54	
Japan	11.14	10.43	8.93	
Germany	7.29	6.55	6.37	
Republic of Korea	2.54	2.95	3.09	
India	1.74	2.36	2.45	
Italy	3.7	2.94	2.42	
France	3.13	2.61	2.34	
Brazil	3.08	2.89	2.26	
Indonesia	1.65	1.7	1.93	
United Kingdom	2.66	2.15	1.93	
Russian Federation	2.15	1.9	1.77	
Mexico	1.91	1.69	1.7	
Canada	2.2	1.57	1.45	
Spain	2.18	1.69	1.44	
Source: UNIDO				
(1) Constant 2010 prices				

4.2 BRIEF HISTORY OF THE SECTOR IN BRAZIL AND THE MAIN INDUSTRIAL POLICIES[65]

The automotive sector, as showed in figure 8, followed a strong growth path since its inception, in the 1950s, until 2013, when production started to fall sharply (this last inflexion is not necessarily a trend, but probably a short-term adjustment to the overall

[65] Part of this section is from parts solely authored by the author of this thesis, already published as chapter 4 of the following jointly-authored publication*: Inovar auto: evaluating Brazil's automotive industrial policy to meet the challenges of global value chains (English).* World Bank Working Paper Report No.121667, 2017. Co-authored with Timothy Sturgeon and Justin Barnes.

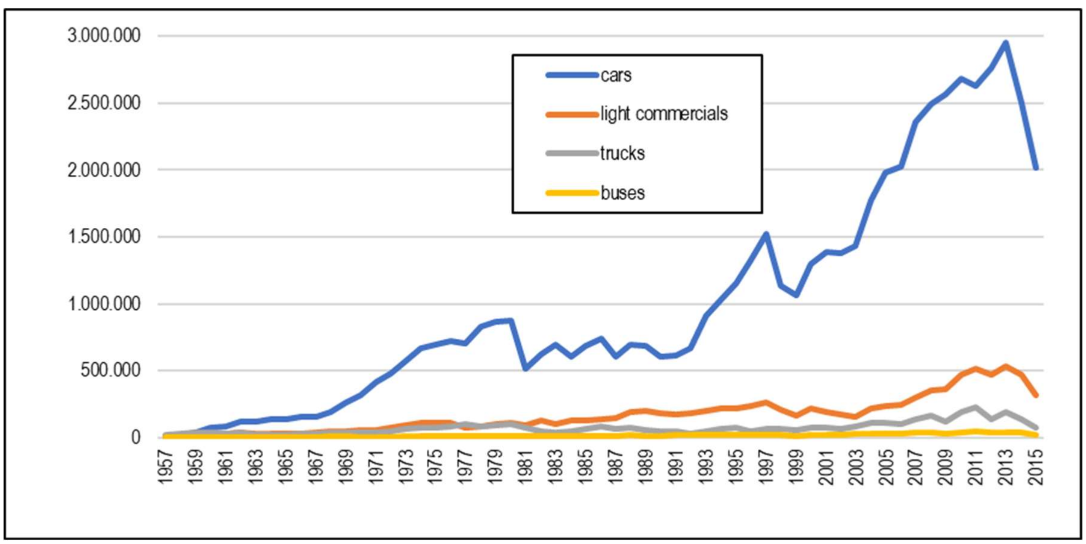
economic crisis faced by the country). We then can group three periods of high production growth for cars:

- 1957-1980: 23.88% average growth, for 23 years;
- 1993-1997: 18.21% average growth for 5 years; and
- 2000-2013: 7.87% average growth for 14 years.

Similarly, the years of most pronounced decreases in car production could be grouped as follows:

- 1981: 41% fall;
- 1998-1999: 32% fall; and
- 2014-2015: 34% fall

Figure 1. Brazilian vehicle production (thousands of units)



Source: Anuario Anfavea.

Production grew after the implementation of the “*Regime Automotivo*” and the sectoral agreements of the 1990s. Based on the discussion in the previous sections, we can infer that these policies successfully helped to increase production. For Inovar Auto, however, the picture is much less clear, since the industry grew immediately after the Program was established but was not sustained thereafter.

However, all such cycles faced by the automotive sector in Brazil broadly corresponded to general cycles in the Brazilian economy, and this makes it difficult to build a reliable counterfactual with the available data. As we shall see in the following sections, we do make some inferences using the production of agricultural machines as a control group, although this is clearly an imperfect one. As we will also see in the following sections, the most reliable inference that can be made with these industry-level data is that Inovar Auto provided some relief against imports, and thus helped domestic players avoid losing market-share to imports.

The industrialization process and the 1950's

Vehicle assembly in Brazil started with the Ford Model T in 1919, followed by General Motors in 1925. These were based on CKDs imports, and thus didn't generate a value chain of auto parts production. However, the auto part industry in Brazil gained a momentum during the Second World War, as imports were affected, and the domestic industry assumed the role to supply spare parts to the vehicle fleet in use within the country. When the war was over, imports of auto parts and vehicles rose again, bringing concerns about trade deficits (Barros and Pedera, 2012).

The import disruption caused by the Second World War had provided an opportunity for indigenous auto part producers, so when the end of the War brought rising imports and balance of trade concerns, the government turned to import substitution policies. Specifically, the Government established, from February 1948 to October 1953, a licensing scheme to allocate foreign exchange in a discriminatory way, favoring capital goods and discouraging imports of consumer goods, including automobiles. Moreover, in 1952 imports of auto parts with similar domestic production were prohibited[66], and in 1953 imports of assembled cars were prohibited[67]. As a result, the use of domestically-made auto parts rebounded to 30 percent local content and the number of members of the Brazilian Professional Association of the Auto part producers, created in 1951, rose from 250 firms in 1952 to 900 registered firms in 1955 (Shapiro,

[66] Advisory 288 , from August/1952.

[67] Advisory 311, from April 1953. The quantitative restriction to imports was ceased only in the 90's (although high tariffs were still present for most of the time thereafter).

1994). By then, Mercedes-Benz, Volkswagen and Willys-Overland started to produce vehicles in Brazil, although at small scales (Barros and Pedera, 2012).

As pointed by Shapiro (ibid), it was only after 1956 when the Government unveiled its "Target Plan" that Brazil began to produce vehicles in high volumes with high local content. The Plan promoted "basic industries". In short, it provided financial incentives and required higher levels of local-content (up to 95% by weight in 1960) to promote import-substitution[68].

The financial incentives were given to projects approved by December 1957 and consisted in a series of subsidies and tax exemptions (Shapiro, 1994):

- Subsidized exchange rates for capital goods imported for FDI, including imports by foreign automakers;
- Subsidized exchange rate for foreign loans borrowed for investments;
- Subsidized exchange rates for importing auto parts not yet domestically produced, with the aim of eventually reaching the required local content levels;
- Fiscal benefits: exemption of import and sale taxes on capital goods purchased by automakers. In the case of trucks, utility vehicles and jeeps also had a sales tax exemption;
- BNDE loans: automakers became eligible for subsidized financing and loan guarantees from the State Development Bank – BNDE.

The first car manufactured in Brazil was the Romi-Isetta, built in 1956 with 70% of local content (Barros and Pedera, 2012). This vehicle was produced under license from Italian automakers by Industria Romi S.A., a Brazilian automaker. The same local content level was achieved for trucks by another indigenous automaker of that time: The National Motor Factory (FNM), also producing under license. It is important to note that licensing designs did not create automotive engineering spillovers.

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[68] As summarized by Shapiro (1989):
By December 1956: trucks: 35%; jeeps: 50%; utility vehicles:40%; cars: none;
By July 1957: trucks: 40%; jeeps: 60%; utility vehicles:50%; cars: 50%;
By July 1958: trucks: 65%; jeeps: 75%; utility vehicles:65%; cars: 65%;
By July 1959: trucks: 75%; jeeps: 85%; utility vehicles:75%; cars: 85%;
By July 1960: trucks: 90%; jeeps: 95%; utility vehicles:90%; cars:95%.

As Shapiro (*ibid*) pointed out, Brazil opted for an import substitution strategy for industrialization, instead of an export-led strategy, because policymakers believed the latter would not be enough to solve the country's growing foreign-exchange constraints[69]. Specifically, regarding the auto sector, the strategy involved taking the firms to a "point of no return", where large upfront investments would be made to comply with the requirements of the policy. The consequence was a large number of entrants with relatively small scale of production, leading to scale inefficiencies that implied higher costs of production. Foreign firms decided to invest, despite these problems, because they were interested in the potential of the Brazilian domestic market[70], and were convinced that there was a time limit to the governmental support[71] (Shapiro, 1994).

It is worthwhile to note that the Brazilian Government did not show a long-lasting commitment to promote a genuine Brazilian car. As the literature indicates, the experience with FNM, an initially state-owned firm, apparently convinced local policymakers that there was no economic reason to promote national champions within the automotive sector, as FDI attraction was from multinationals was successful.

The strategy was successful in terms of attracting investment and creating employment for both assembly and parts, as pointed by Shapiro (*ibid*): By 1961 there were eleven automakers operating in the country, producing with an average local-content of more than 90% by weight and almost that figure by value; After some consolidation, production almost doubled from 1961 to 1968 and reasonable economies of scale were achieved[72]; By 1975, Brazil was the ninth largest producer of automobiles in the world.

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[69] As reasons for this belief the author cites the limited export market in post-war 1950s and the dominance of agricultural items in the Brazilian exports.

[70] Shapiro (1989) uses Argentina as a comparison for this argument, stating that this country had similar policies to attract FDI for the sector in 1958, but did not succeeded as Brazil, mainly because of its smaller domestic market.

[71] As stated by Shapiro (*ibid*), historical evidence suggests that policy requirements were a determinant factor in making the multinational automakers investing in domestic production in Brazil, even if this investment was only the anticipation of decisions already taken.

[72] Shapiro (1994) cites evidence that shows that, in 1967, ex-factory costs in Brazil were 1.7 times higher than in the United States, mainly because of tax differentials (without taxes the cost differential would be reduced to 1.28, and scale would be the main cause for it). The author also cites that this cost differential was reduced in the 1970s and that in the early 1980s Brazilian prices, net of taxes, were lower than similar models in foreign markets.

In the 1970s, the foreign automakers producing in Brazil asked for a withdrawal of incentives to deter new entrants. The Government ended the incentives in 1974 with the rational of further increasing the average scale of production[73] (Guimaraes, 1989).

After 1975 the Government started to promote vehicle exports. The main motivation, according to Shapiro (*ibid*), was to improve the country's the trade balance. Barros and Pedera (2012) emphasizes that the government adopted policies to promote exports of auto parts and to incentivize R&D through financial support for the automakers producing domestically. In the 1980s, exports did grow substantially, especially since the country faced a long-lasting economic crisis in the 1980s and domestic demand for vehicles fell, forcing the industry to resort to exports. The 1980's crisis was so severe that, even with growing exports, domestic production recovered to levels reached in 1979 only in 1993.

The trade liberalization and the 1990's automotive strategy

In the early 1990s the Government pushed further the trade liberalization agenda, eliminating non-tariff barriers and reducing tariffs, including in the automotive sector. The so-called "Regime Automotivo Brasileiro" also promoted cost (achieved by lower taxes) and price (achieved by reduced profits) reductions within the sector, which led to rising sales and production: Between 1992 and 1993 the Government, the automakers, the auto parts producers, the dealers and the workers set up a series of agreements ("Acordos Automotivos") meant to achieve the following goals: a) price reduction of 22%, following a reduction in taxation (IPI, ICMS) and in profit margins (for automakers, auto part producers and dealers); b) public commitment to keep the level of employment at July 1993 levels; c) better financial conditions for vehicles purchases; d) increasing production targets and new investments within the sector. Furthermore, in April 1993 the Government launched Decree 799, reducing the IPI from 8% to 0.1% for cars with low cylinder capacity, thus promoting the production of these so-called "popular" vehicles, with production initially led by Volkswagen and Fiat (Barros and Pedra, 2012).

[73]In the 1970s, the last firm to get subsidies and enter the market was FIAT (initiated production in 1976).

With inflation under control after 1994, there is further growth in vehicle sales. However, the rapid increase in imports in 1994 brought new concerns about the trade balance. Thus, the Government resorted to measures to reduce consumption, including higher import tariffs and quotas.

In 1995 and 1996 President Cardoso implemented the “Regime Automotivo Brasileiro” (Brazilian Automotive Regime and the Special Regime)[74]. This policy, set to expire in 31/December/1999, consisted of a series of tax incentives for FDI in new plants in Brazil, especially in less developed regions and for the existing domestic producers:

- Reduction of import taxes for vehicles imported by carmakers operating in Brazil; for capital goods; and for raw materials and auto parts;
- For vehicles, the policy stated that the total subsidized imports should be less than the total exports;
- For auto parts, the policy stated that the total subsidized imports should be less than 2/3 of total exports;
- Local content requirement was 60% of the value of inputs used in the vehicle production (new automakers had 3 years to start complying with the LCR target).

The Special Regime had more incentives, specially designed for new investments in the least developed regions (Northeast, North, and Centre-West). These incentives contained a series of tax abatements, including further reduction in import taxes and IPI for capital goods; reduction of IPI for inputs; and exemption of Income tax and others.

The policy was apparently successful regarding import substitution and increasing the geographic diversity of the industry within Brazil. De Negri (1999) points that the automakers reached a local content above 80% (much higher than the required levels), the trade deficit was eliminated, and production was geographically dispersed

[74] Provisional Measure n. 1,024, from 13/June/1995, converted into the Law n. 9,449/97, from 14/March/1997; Provisional Measure n. 1,235/1995; Presidential Decrees 1,291/1995 and 1,761/1995; and, for the Special Regime, the Provisional Measure n. 1,532/1996, converted into the Law n. 9,440/1997.

in Brazil for the first time. Moreover, according to Arbix (2000), the successful result came quickly, with 16 automakers within the Automotive Regime. The amount invested under the Program by the firms was similar in scale to the investment made in the 1950s and1960s.

Arbix (*ibid*) presents survey data from the National Confederation of Industries -CNI and the ECLAC/UN that revels investor motivations for choosing specific investment locations within the New Automotive Regime in the 90s. The most important factors identified by respondents were equally “proximity with the market” and “financial benefits” and secondarily “labor costs” and “local incentives and advantages”.

However, at the end of the 90s, crisis hit again with a new, short cycle of devalued exchange, higher taxation, and lower domestic demand, leading to a short-term hike in exports (2002 and 2003).

The 2010 import boom and the birth of Inovar Auto

After 2003 the Brazilian economy began to recover from 6 years of crisis caused by a combination of the international financial crisis from the late 90s; energy shortages; political uncertainties; trade imbalances. The prospects of a Government with more than expected market-friendly policies and the fiscal windfall generated by a new commodity boom provided the background for rising confidence, production, real wage gains and consumption in through 2014.

In the aftermath of the 2008 global financial crisis production and sales dropped, but the country experienced a relatively quick recovery. Among the policies implemented to offset the effects of the 2008 crisis there was the availability of cheap credit trough PSI line (“*Programa de Sustentação do Investimento*”), operated by BNDES. Despite these efforts, investments by auto parts suffered a huge setback in 2009, and auto part producers have been unable to match the investments made by automakers since (Barros and Pedra, 2012).

Meanwhile, given the increasing strength of the Real, and the robust domestic demand since 2004, sales of imported vehicles grew substantially, reaching 34.8% of apparent domestic consumption in December 2011. This was viewed as a threat by the locally based automakers, who then asked for protection against imports. The auto part producers joined the request, asking for the establishment of minimum local content requirements. After negotiations with the Government, a 30-percentage points differential in the IPI tax rate between imported and domestic produced vehicles was established in 2011. Since 2012 this differential was included, together with other measures, in a policy called Inovar Auto.

According to Anfavea, the Brazilian automotive producer association, Inovar Auto increased local production by 10% in 2013, reflecting a reduction in import penetration, and promoted new investments of over 30 billion dollars until 2017. However, investment in new plants and capacity was already growing in the 2000s, even before Inovar Auto was conceived. Similarly, FDI had started to increase sharply in 2010 – before Inovar-auto was conceived.

Inovar Auto as a tax expenditure and its case at the World Trade Organization

Two dispute cases involving Brazilian tax expenditures were initiated under the WTO dispute settlement system[75]. According to the WTO, at DS 472 the European Union requested a panel in October 2014 (established in December 2014 and composed in March 2015), after almost one year of consultations.[76] The consultations discussed taxation not only in the automotive sector, but also in electronics and included debates on the use of Free Trade Zones and differential tax treatments for exporters. The allegations were that Brazil didn`t comply with a series of WTO rules[77].

Consultations requested by Japan[78] in July 2015 culminated in a panel established and composed in September 2015, for the dispute DS 497, with the allegation that Brazil didn`t comply with the GATT 1994; the Subsidies and Countervailing Measures

[75] DS 472 and DS 497.

[76] Third parties in the panel are: Argentina, Australia, China, India, Japan, Korea, the Russian Federation, Chinese Taipei, Turkey, the United States, Canada, Colombia and South Africa.

[77] More precisely: articles I:1, II:1(b), III:2, III:4, and III:5 of the GATT 1994; article 3.1(b) of the Subsidies and Countervailing Measures Agreement; and articles 2.1 and 2.2 of the Trade-Related Investment Measures (TRIMs) agreement.

[78] Third parties in the panel are: Argentina, Australia, China, the European Union, India, Korea, the Russian Federation and the United States.

Agreement; and the Trade-Related Investment Measures (TRIMs) agreement. The panel in the dispute DS497 is the same as in the dispute DS 472, and thus both followed a harmonized procedure.

The publicly available documents at the WTO website show that the consultation requested by the European Union pointed to the following tax measures:

- The Programme of incentive to the technological innovation and densification of the automotive supply chain Law (*Programa de Incentivo à Inovação Tecnológica e Adensamento da Cadeia Produtiva de Veículos Automotores - "INOVAR-AUTO"*);
- the Informatics Programme (*Lei de Informatica*);
- the Digital Inclusion Programme (*Programa de Inclusão Digital*);
- the Programme of Incentives for the Semiconductors Sector (*Programa de Incentivos ao Setor de Semicondutores - PADIS*);
- the Programme of Support to the Technological Developments of the Industry of Digital TV Equipment") (*Programa de Apoio ao Desenvolvimento Tecnológico da Indústria de Equipamentos para TV Digital - PATVD*);
- the Special Regime for the Purchase of Capital Goods for Exporting Enterprises (*Regime Especial de Aquisição de Bens de Capital para Empresas Exportadoras - RECAP*);
- the export contingent subsidies for predominantly exporting companies (*Empresas preponderantemente exportadoras*) concerning the Purchase of Raw Materials, Intermediate Goods and Packaging Materials;
- The Manaus Free Trade Zone (Zona Franca de Manaus).

The consultation requested by Japan had all but the Manaus Free Trade Zone item. According to both consultations, these measures discriminate foreign producers by commanding a higher taxation on imports and export contingent subsidies. Specifically regarding Inovar Auto, the claim is that the Program discriminates in favor of domestic production and in favor of some WTO members over others.

The Panel Report was circulated on 30/August/2017, and concluded that:

a) Regarding most-favored nations claims: Brazil could not have implemented discriminatory internal taxation measures, treating imports from the E.U. and Japan differently from imports from Mexico and Mercosur;
b) Regrading National Treatment claims: The Panel concluded that the tax discriminations against imports and the local content requirements favor domestic production in a way that is inconsistent with WTO rules.

Inovar Auto is considered a tax expenditure, as it constitutes an exception from the normal tax code and, following Hashimzade et al (2014), this exception is motivated by a specific policy that benefits a sector in a way that is analogue to a budget expenditure[79].

Another important fact is that Inovar-Auto elevated the level of protection against foreign competition in 30 percentage points since 2011, that, adding to the import tariff of 35% and to the substantial currency devaluation since 2011 promoted a sizeable barrier to foreign competition. It is therefore possible that the Brazilian auto sector is being excessively protected and that this is contributing to a situation where firms operate with smaller scales than otherwise. To be exempt from this surcharge, an assembler needs to comply with local content requirements. However, local contents have the same effect as trade barriers on imported inputs: they make these inputs more expensive, thus damaging the competitiveness of the domestic value chain.

Overall, the Brazilian value chains show tariff escalation: the tariffs for the automotive sector were the following:
Average nominal tariff within the first transformation: 14.3%
Average nominal tariff within the second transformation: 14.9%
Average nominal tariff within the third transformation: 31.1%
Source: UFRJ (2015).

[79] The Brazilian Internal Revenue Secretariat defines tax expenditures in a similar way: "Gastos tributários são gastos indiretos do governo realizados por intermédio do sistema tributário, visando atender objetivos econômicos e sociais. São explicitados na norma que referencia o tributo, constituindo-se uma exceção ao sistema tributário de referência, reduzindo a arrecadação potencial e, consequentemente, aumentando a disponibilidade econômica do contribuinte. Têm caráter compensatório, quando o governo não atende adequadamente a população dos serviços de sua responsabilidade, ou têm caráter incentivador, quando o governo tem a intenção de desenvolver determinado setor ou região"(SRFB, 2015).

This means that the automotive sector shows strong tariff escalation for the third transformation – the manufacturing of cars, trucks, buses and motorcycles. However, the tariff escalation within lower levels of the value chain is not noticeable, despite the high tariff levels observed. This could indicate that autoparts are buying inputs with high tariffs, both in relative and in absolute terms. The highest effective tariffs in Brazil are for trucks, buses, cars and light commercials. These industries also have the highest nominal tariffs. This means that their nominal tariff is much higher than the one applied for its inputs.

In the case of electronics and telecom goods, there is no tariff escalation, as the inputs are taxed heavier than the other transformation phases.

Without any static consideration regarding consumer prices, the concept of effective protection shows clearly that when a tariff is imposed on an input, ceteris paribus the final good will be less protected. In the Brazilian automotive sector, there are high tariffs for autoparts (inputs), and, in order to avoid a loss in effective protection for the automakers (final goods), even higher tariffs were needed (and were imposed) on vehicles. An example of an opposite approach is from the aeronautical sector: input tariffs are relatively lower, thus increasing effective protection for aircrafts and, at the same time, increasing its international competitiveness.

4.3 A BEFORE-AND-AFTER ANALYSIS OF INOVAR-AUTO[80]

Estimating the Impact of Inovar Auto

What has been the effect of Inovar Auto? Because the program affects all firms in the sector, there is no easy candidate for a control group and, therefore, no rigorous way to judge its impact against a counterfactual outcome. Thus, our analysis will be based

[80] Part of this section is from parts solely authored by the author of this thesis, already published as chapter 4 of the following jointly-authored publication: *Inovar auto: evaluating Brazil's automotive industrial policy to meet the challenges of global value chains (English).* World Bank Working Paper Report No.121667, 2017. Co-authored with Timothy Sturgeon and Justin Barnes.

on a non-experimental design, seeking to make inferences about the impact of the Program on the automotive sector before and after its implementation, while remaining aware of the limitations of the analysis in terms of internal validity[81]. To deal with these limitations we will use complementary (comparable) information when available. This can be data on the entire Brazilian manufacturing sector or on adjacent industries (agricultural vehicles and motorcycles, for instance), or the identification of historical trends.

It is not straightforward to define a point in time were Inovar Auto started affecting economic agents. The Policy was set up trough successive pieces of legislation, with different effects:

- 02/August/2011: Provisional Measure 540, effective to deter imports after December and not effective regarding local content requirements.
- 14/December/2011: Conversion into Law 12.546
- 03/April/2012: Provisional Measure 563, set up of Inovar Auto, more effective to deter imports and with more detailed commands regarding local content requirements.
- 17/September/2012: Law 12.715: Inovar Auto converted into Law.
- 03/October/2012: Decree 7819: Inovar Auto fully effective.

In this analysis, we position the start of Inovar Auto as when MP 563 was issued: April 2012.

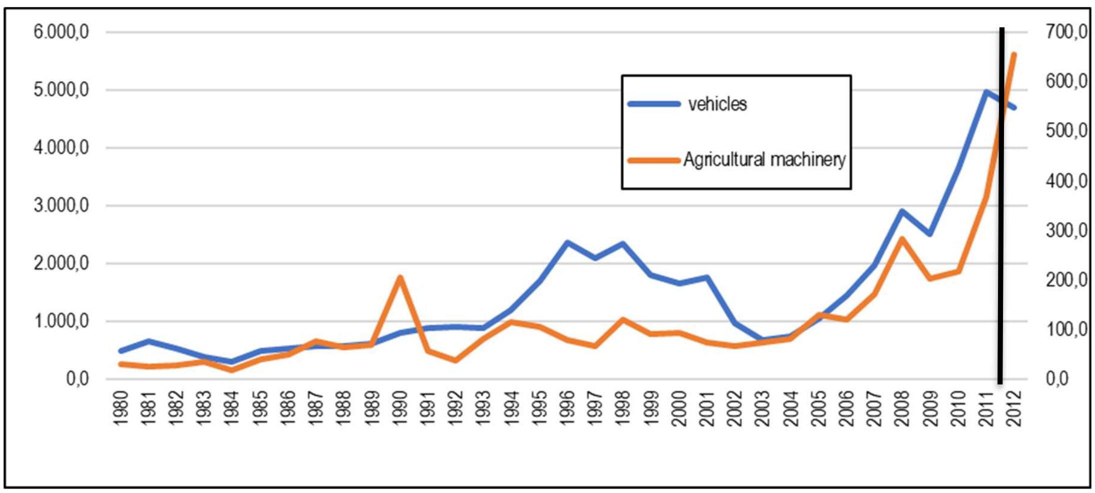
Output, Sales, Investments, and Employment

It can be seen from figure 2 that there was an upward trend in automotive sector investment in the between 2005 and 2011. If we take the investment in agricultural machinery not covered by Inovar Auto as a control group, we see a very similar pattern, apart from 1995-2001, a period where the 1995`s policy seemed to have played a role in promoting investment for the automotive sector. However, we must

[81] Because there is no control group it is not possible to establish a clear causal relationship and therefore estimate the impact of the Program: other factors could be affecting the changes in the m, measured variables. The most important potential factors that in our view could affect the outcomes are the macroeconomic environment and the business cycle for the industry (similarly to a “regression-to-the mean”).

acknowledge that this period was characterized by strong outward investment by automakers and global suppliers (see section 1 of this report and Sturgeon and Florida, 2004). Market saturation in OECD countries led to a huge investment wave in large emerging markets such as China, India, and Brazil. So, there was a general "push" in the global industry for outward investment to big emerging markets such as Brazil, as well as "pull" from policies. Following the arguments presented in the analysis of the previous policies, data seems to confirm that automakers invested because of growing domestic demand and potential demand. In this sense, policy, at best, only accelerated a trend that was already under way, driven by the corporate strategies of global automotive firms.

Figure 2. Investments in production



Source: Anuario Anfavea

Another important consideration is how much of the announced investments after Inovar Auto were in fact "caused" by the Program. With the available data we can only make some inferences. To do this exercise we will assume that a typical investment decision would be taken at least 3 years before production is initiated. Another assumption is that Inovar-Auto began to influence investment decisions on the 14th of December, 2011. From these assumptions, we assume that any production that was planned to start before December of 2014 is was decided prior to Inovar Auto. Our calculations use data from investment commitments and employment forecasts released by the firms through 2015.

Table 4 shows the results: According to our assumptions, the Program could be responsible for only 51% of the investment committed and 52% of the jobs predicted. These figures are not far from other results in the literature: studies surveyed by James (2009) show that the percentage of firms that would have invested even without the tax incentive range from 51% to 85%.

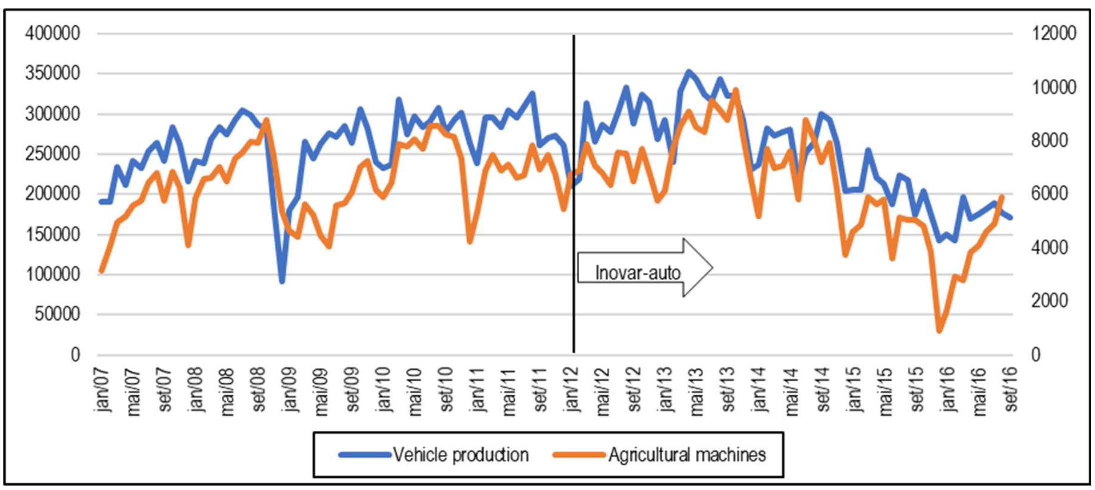
Table 4. Announced Investment 2013-2017

FIRM	INVESTMENT COMMITED (R$ milions)	FORECASTED PRODUCTION CAPACITY (Units)	EXPECTED DATE TO START PRODUCTION(*)	EXPECTED JOB CREATION (Persons)	HYPOTHESIS(**)
AUDI DO BRASIL DIST. DE VEÍCULOS LTDA (Projeto A3 e Q3)	670	26.000	4º trim 2015	400	INFLUENCED BY INOVAR
BMW DO BRASIL LTDA.	625	32.000	1º trim 2014	1.300	ALREADY DECIDED
CAMINHÕES METRO-SHACMAN DO BRASIL, COM. E IND. DE VEIC. AUTOMOTORES LTDA.	329	10.000	4º trim 2014	300	ALREADY DECIDED
CAOA MONTADORA DE VEIC. PROJETO (Ix35)	300	24.000	3º trim 2014	550	ALREADY DECIDED
CHERY BRASIL IMP.FAB.E DIST.VEIC.	351	100.000	1º trim 2014	1.700	ALREADY DECIDED
DAF CAMINHÕES BRASIL INDÚSTRIA LTDA.	351	10.000	4º trim 2013	500	ALREADY DECIDED
FOTON AUMARK DO BRASIL - Fábrica no Rio Grande do Sul	239	34.000	2º trim 2015	307	INFLUENCED BY INOVAR
FOTON MOTORS DO BRASIL LTDA - Fábrica na Bahia	301	16.000	2º trim 2015	500	INFLUENCED BY INOVAR
JAC MOTORS DO BRASIL AUTOMÓVEIS	900	80.000	1º trim 2015	3.000	INFLUENCED BY INOVAR
JAGUAR E LAND ROVER BRASIL IMPORTAÇÃO E COMÉRCIO DE VEÍCULOS LTDA.	904	24.000	3º trim 2016	1.360	INFLUENCED BY INOVAR
MERCEDES-BENZ DO BRASIL LTDA (Projeto Clase C e GLA)	709	20.000	1º trim 2016	1.000	INFLUENCED BY INOVAR
MMC AUTOMOTORES DO BRASIL LTDA (Projeto ASX)	283	27.000	2º trim 2013	324	ALREADY DECIDED
MMC AUTOMOTORES DO BRASIL LTDA (Projeto LANCER)	193	21.715	1º trim 2014	300	ALREADY DECIDED
NISSAN DO BRASIL AUTOMOVEIS LTDA (INCISO III)	2.500	160.000	1º trim 2014	2.700	ALREADY DECIDED
SBTC INDÚSTRIA DE VEÍCULOS S/A	199	5.000	1º trim 2016	850	INFLUENCED BY INOVAR
VOLKSWAGEN DO BRASIL IND. DE VEÍCULOS AUTOMOTORES (Projeto GOLF)	505	40.000	3º trim 2015	400	INFLUENCED BY INOVAR
TOTAL	**8.688**	**603.715**	**-**	**15.091**	
TOTAL INFLUENCED BY THE POLICY(***)	**4.426**			**7.817**	
%	**51%**			**52%**	

Source of primary data: Ministry of Industry and Foreign Trade. Author`s calculations.
(*) Dates were given by firms to the Ministry of Industry and Foreign Trade when enrolling in the Program Inovar-Auto and includes updates until 2015. (**) As a result of the following assumptions: a) An investment decision is taken at least 3 years before production takes place; and b) The Policy started to influence investment decisions on 14/December/2011. Thus, any production planned to start before the end of 2014 is deemed to be already decided before Inovar-Auto. (***) Total investment committed and job creation assumed to be resultant from the Program, according to our assumptions.

Figure 3 shows the number of vehicles produced in Brazil quarterly from 2007 to September 2016. Using agricultural machines as a control group, it is not possible to infer that production of motor vehicles has been affected by Inovar Auto. However, this control is not perfect, as one could argue that imports of agricultural machines were not a threat to domestic production as it were in the case of vehicles. The point here is, as we shall see throughout this section, that although Inovar Auto may have shifted demand from imports to domestic production in the short-term, thus briefly boosting and then slowing the decline in domestic production, it did not alter the competitiveness of the industry enough to allow Brazilian production to grow despite the domestic crisis trough exports or trough costs and price reductions in the domestic market.

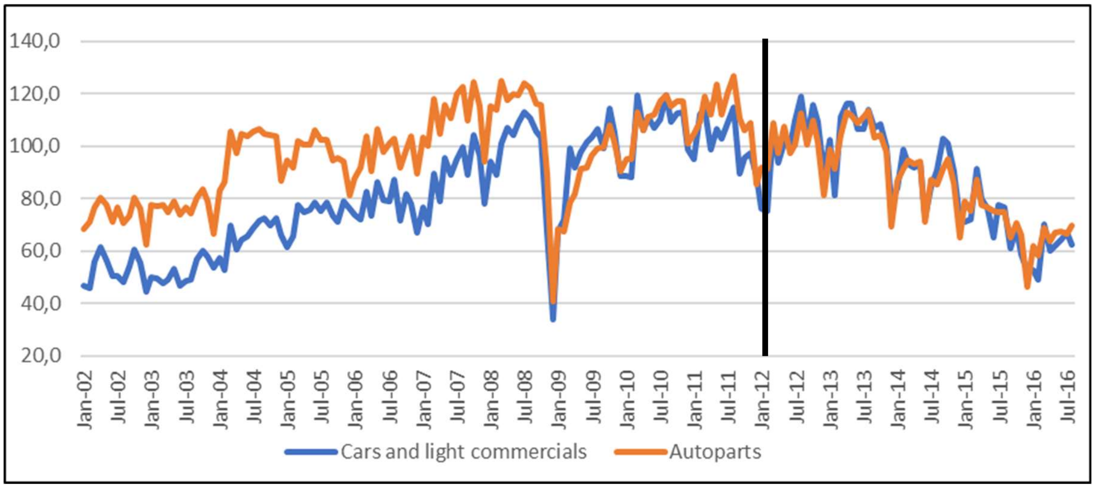
Figure 3. Units produced



Source: Anfavea website

Monthly production data from PIM/IBGE (figure 4) also shows that Inovar Auto did not have a clear impact on the production of both vehicles and auto parts.

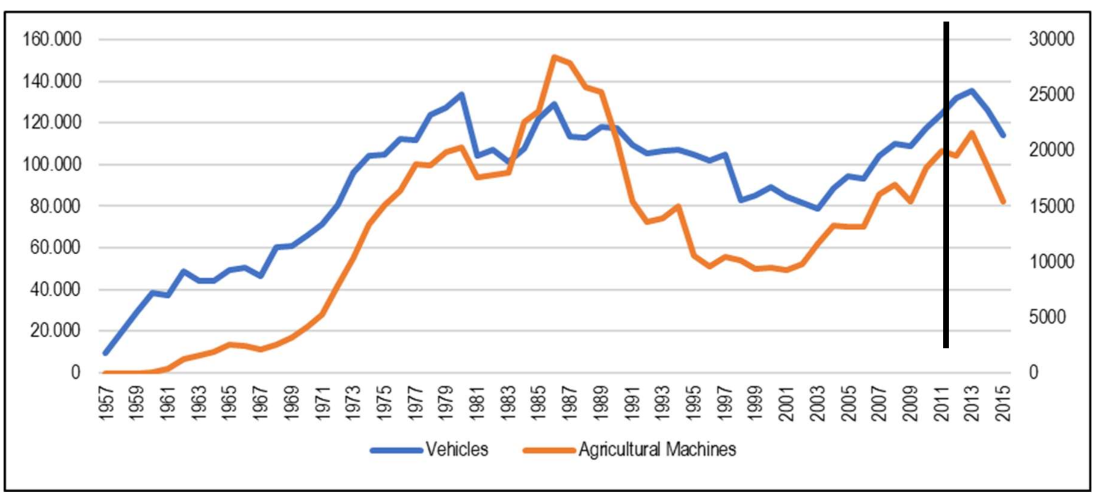
Figure 4. Production index (2012=100)



Source: PIA (Pesquisa Industrial Anual) - IBGE

Apparently, Inovar Auto had no impact on employment, as can be inferred from figure 5.

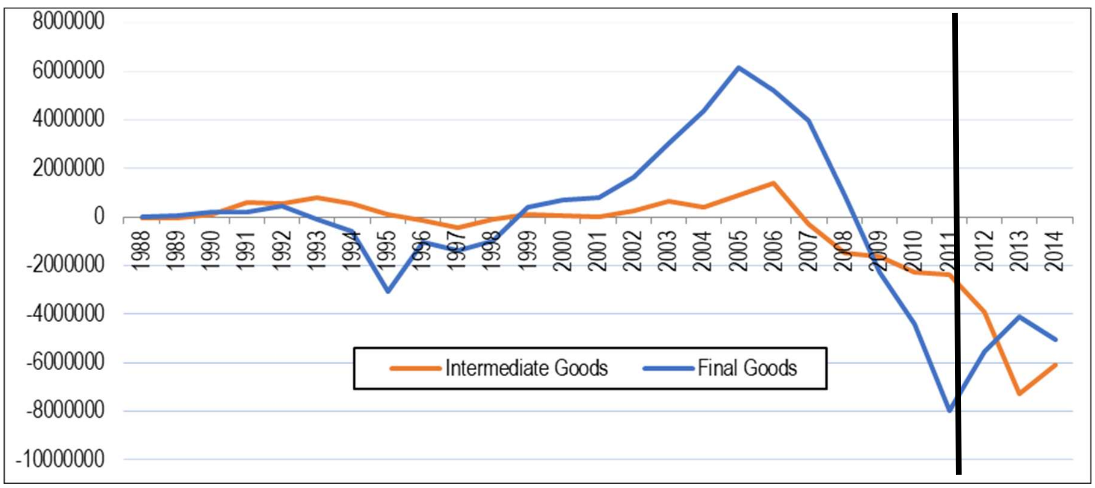
Figure 5. Employment (number of workers): vehicle production and agricultural machines production



Source: Anuario Anfavea

As explained in section 4, Inovar Auto represented a barrier to imports. Not surprisingly, it likely succeeded in reducing the import penetration in the Brazilian market, as is suggested by the trade statistics (figure 6). In this case, there was an effective trade barrier since December 2011, when imports were due to pay the increased IPI tax. There was, however, a delay in import reduction for auto parts, what could be explained by the time required to domestic sourcing and by the time required to assure compliance with the local content requirements.

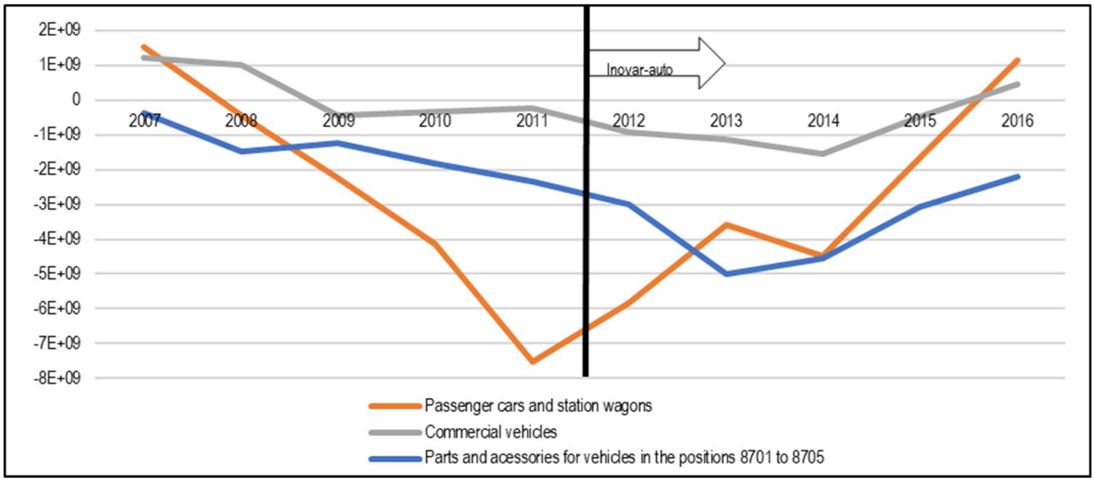
Figure 6. Brazil motor vehicle trade balance (current US$ thousands)



Source: United Nations Comtrade database

A more detailed look (**figure 7**) at Brazil's trade balance in vehicles and parts confirms that passenger cars were the most affected by imports before Inovar Auto, and that this trend was reversed after the policy came into effect in 2011. The trend for auto parts began to change only in 2013, when the Government gained the legal provisions needed to enforce compliance with local content requirements.

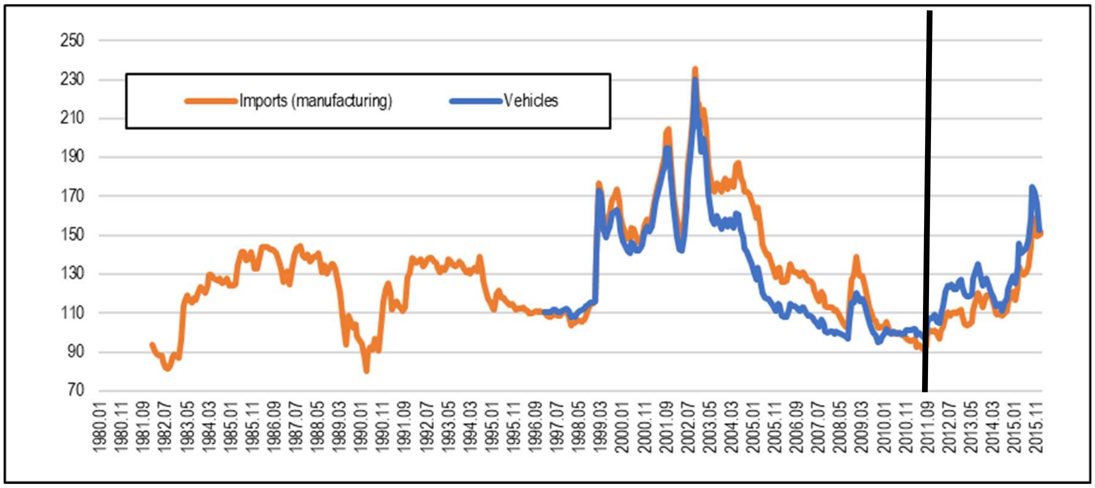
Figure 7. Brazil automotive vehicle trade balance (current US$ thousands)



Source: AliceWeb - Brazilian Ministry of Trade

The reason for the sharp deterioration of the Brazilian trade balance in vehicles from 2006 to 2011 was a combination of growing domestic demand, which diverted exports to the local market, and the increasing value of the domestic currency, which overpriced exports and made imports more appealing. The peak in terms of value for the Brazilian currency was 2010-2011, when it reached a level very close to that of 1997-1998. Similar data for manufacturing as a whole suggests that the level reached in 2011 was also similar to the level reached in 1990, when the market was opened, and not so far from 1994-1998 levels (figure 8). In other words, the last three times the domestic currency reached such levels policy responses followed.

Figure 8. Real effective exchange rate (2010 = 100)



Source: IPEADATA

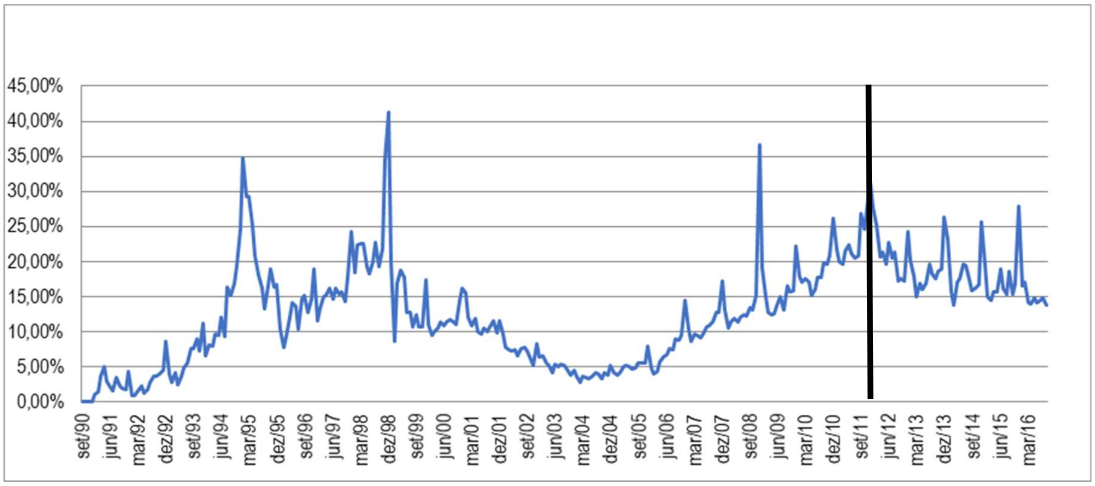
Note: INPC price index. Trade-weighted currencies.

From figure 8 we also see that after the protection was brought by Inovar Auto the country faced a deterioration of its currency, what means that the real protection for the sector started to increase substantially above what was deemed as necessary by the policy.

Another way to explore how Inovar Auto reduced imports is to examine the import penetration coefficient (figure 9). This is calculated dividing imports by apparent consumption[82]. The results also show that Inovar Auto may have broken a trend of growth in import penetration that has been in place since 2004. The average level over the last 4 years is nonetheless similar to the average level verified in the 4 years after the 1995's policy: around 20%. This could indicate two things: 1) During the 6 years before the implementation of Inovar Auto the industry was indeed suffering from a relatively fast growth of imports – what could have justified the concerns among the domestic producers; and 2) The import penetration was very low in 2004-2008, meaning that the concern highlighted in item "1" could be somehow unjustified.

[82] Apparent consumption = Production + imports – exports.

Figure 9. Monthly import penetration- total vehicles



Source: Anfavea (Anuario and Cartas Anfavea)

Although the trade balance data and the import penetration coefficients allow us to make inferences, it is also informative to examine measures of revealed comparative advantage, as a proxy for external competitiveness[83]:

Revealed Comparative Advantage in Exports (Balassa index) - RCAE:

(VEHICLES EXPORTS BRAZIL/TOTAL EXPORTS BRAZIL) / (VEHICLES EXPORTS WORLD/TOTAL EXPORTS WORLD)

Revealed Comparative Advantage in Imports - RCAI:

(VEHICLES IMPORTS BRAZIL/TOTAL IMPORTS BRAZIL) / (VEHICLES IMPORTS WORLD/TOTAL IMPORTS WORLD)

Net Revealed Comparative Advantage – NRCA:

RCAE - RCAI

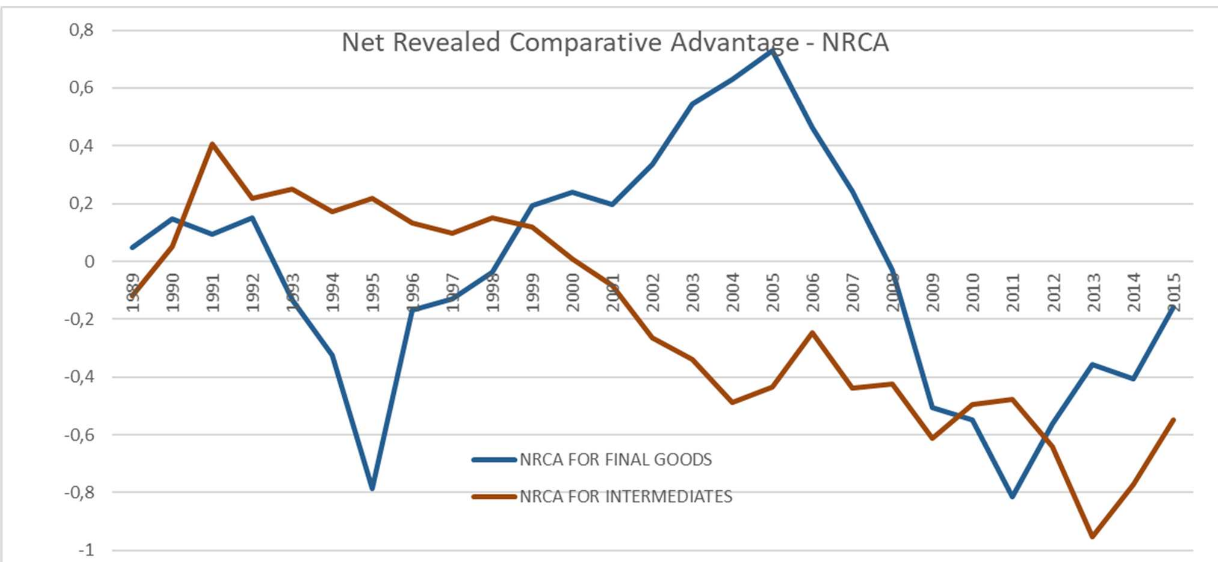
NRCA is a combination of RCAE and RCAI, and a higher NRCA means higher competitiveness. This is related to trade balance, as it includes exports and imports,

[83] As these measures do not disentangle the effects of subsidies and pro6ection, they are not measures of "pure" competitiveness.

but it emphasizes the differences in the ratios of export and imports between the observed country and the rest of the world.

Clearly, Brazilian vehicle production faced stronger competition from abroad during the periods 1993-1996 and 2008-2011. Interestingly, years 1994/1995 and 2010/2011 were practically identical bottom points in terms of the index (figure 10), and both points coincide with the timing of the discussions that led to both policies "Regime Automotivo" and "Inovar Auto". Moreover, the data suggests that the implementation of both policies seem to have coincided with improved competitiveness. For auto parts, data show an opposite trend between 1991 and 2005, as auto parts production in Brazil lost competitiveness starting in 1992. Since 2006 final goods joined this loss of competitiveness until the trends reversed in 2001 for vehicles and 2013 for parts.

Figure 10. Net Revealed Comparative Advantage- NRCA

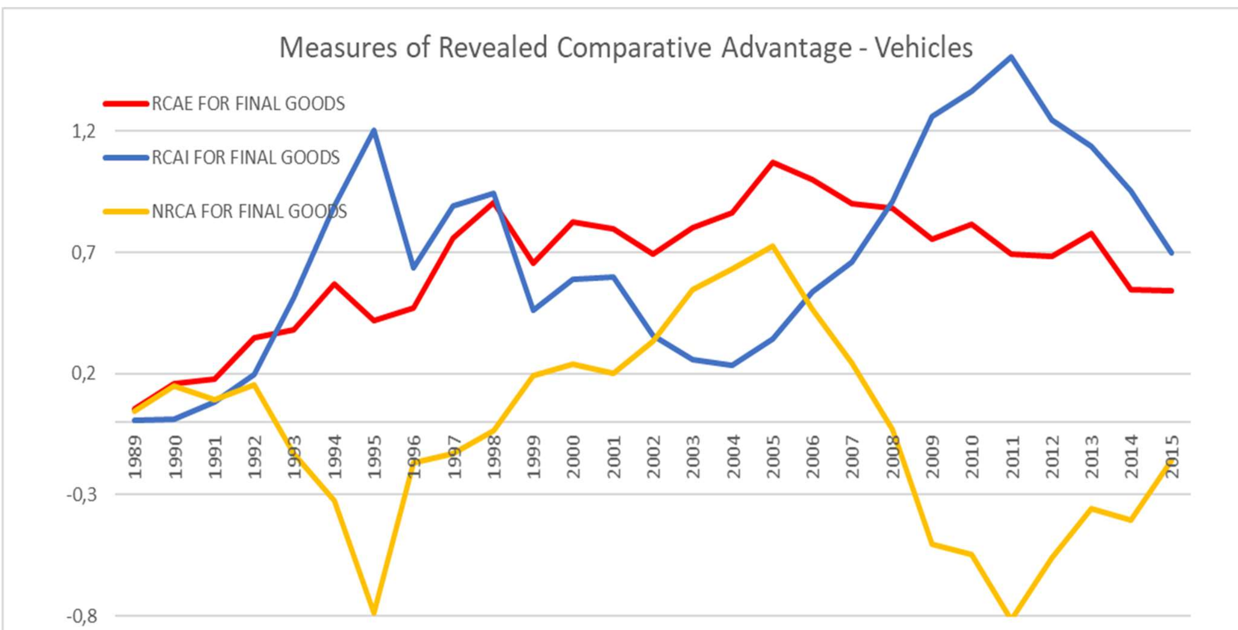


Data source: United Nations Comtrade database.

To shed more light on the issue, we disaggregated the NRCA vehicle index into its two components: RCAE and RCAI. As we can see, from figure 11, RCAE does not seem to have been impacted by either policy regime. This suggests that Brazilian vehicle exports were driven by other factors, such as the capacity of the domestic market to absorb domestic production. In the years when the domestic demand is weaker, RCAE is higher. This illustrates how the Brazilian automotive sector is focused on the domestic market, turning to exports to provide relief during periods of slumping domestic demand. RCAI, on the other hand, matches (with opposite signals, as it shows the strength of imports) the NRCA curve. As there was no major structural change for the Brazilian competitiveness, the explanation for these movements is likely to be the exchange rate and tariffs (protection from or exposure to imports).

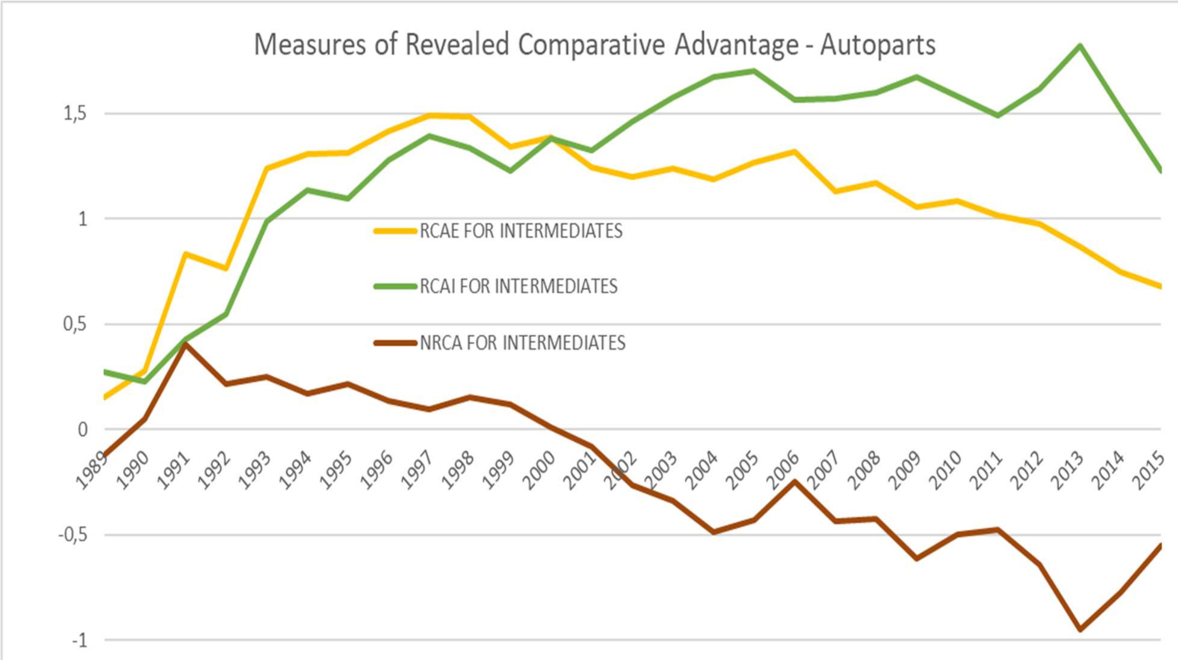
For auto parts (figure 12), RCAI was growing faster than RCAE (higher comparative advantage in exports) since 1991, resulting in a deteriorating NRCA. This means that in the 1990s Brazilian auto parts lost competitiveness because firms were not able to withstand import competition, while in the 2000s Brazilian auto parts also lost capacity to compete in foreign markets through exports.

Figure 11. Other measures of revealed comparative advantage - vehicles



Data source: United Nations Comtrade database

Figure 12. Other measures of revealed comparative advantage- auto parts

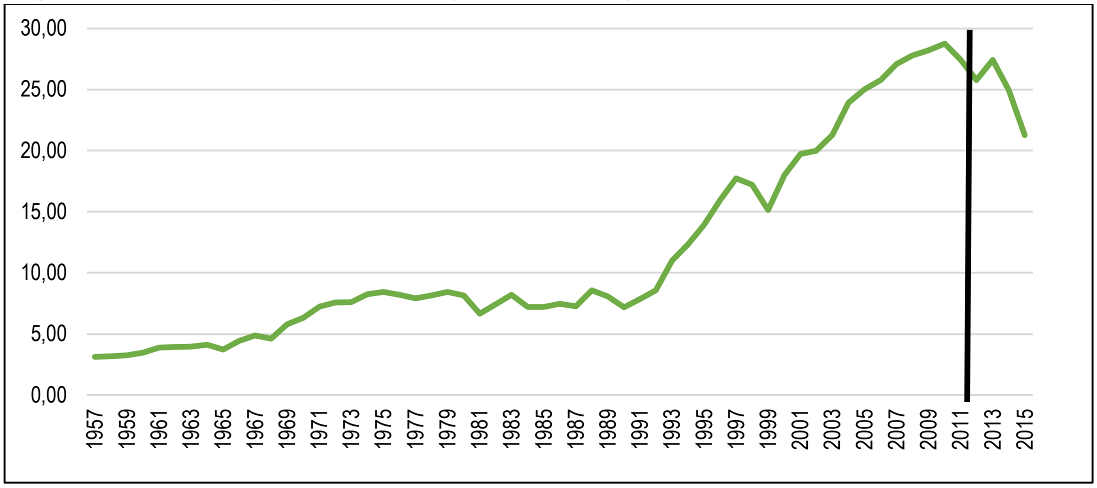


Data source: United Nations Comtrade database

Prices, Costs, Margins, Productivity, and Scale

Overall, labor productivity (figure 13) as measured by vehicles per worker rose until the 2010-2011 period, notably in the years when production was growing the fastest. Since then, given the reduction in production, productivity has fallen sharply. Thus, these results could be simply a consequence of excess capacity and employment rigidity, not labor efficiency. As with output, there is no clear link between Inovar Auto and labor productivity in Brazil’s automotive sector.

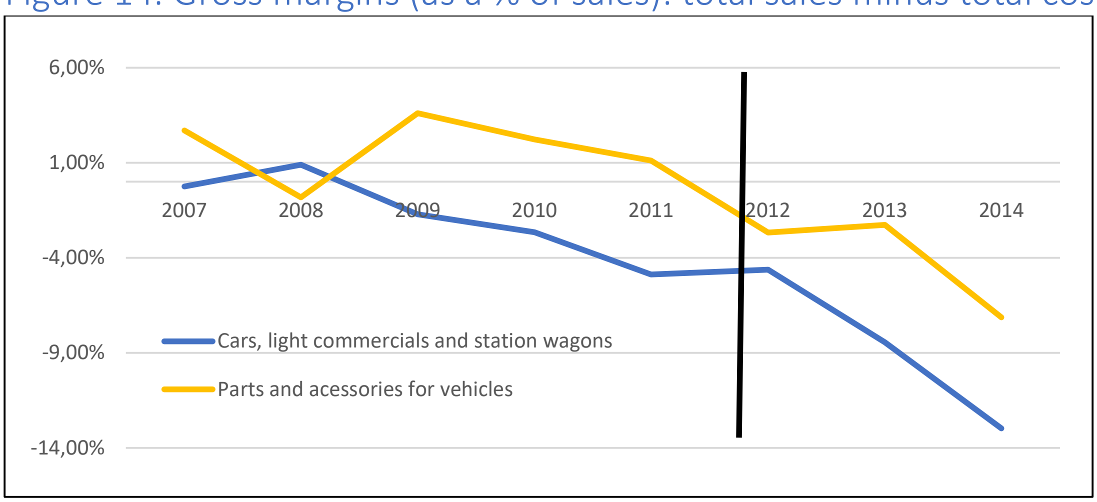
Figure 13. Labor productivity (vehicles per worker)



<u>Source</u>: Anuario Anfavea

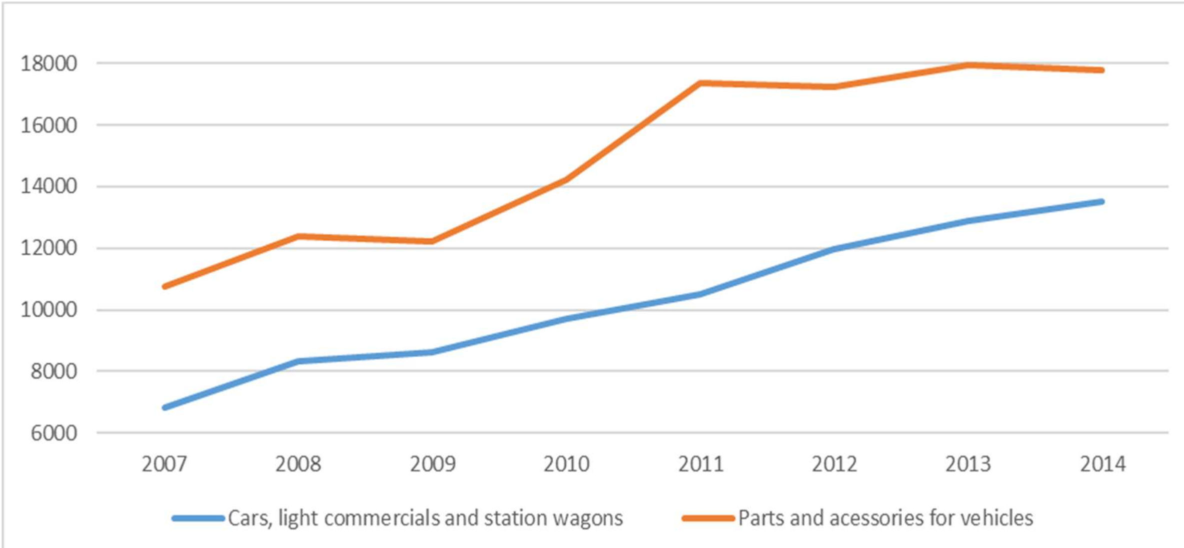
The difference between total sales and total costs show that this margin, for cars, was decreasing since 2008, and that Inovar Auto may have halted this trend only for one year, as margins were fell again from 2012 onwards. Auto part producers followed a similar trend since 2009, but again with a lag in relation to the automakers. In sum, Inovar Auto may have had a short-term effect on auto part firms, with a one-year lag relative to vehicle producers (figure 14). Protection was not sufficient to avoid the reduction in margins for automakers and for auto parts producers. The main reason is because costs kept rising from 2012, while sales were stagnated. Figure 15 shows how car manufacturing in Brazil kept following a trend of increasing labor costs.

Figure 14. Gross margins (as a % of sales): total sales minus total costs



<u>Source</u>: PIA (Pesquisa Industrial Anual) - IBGE

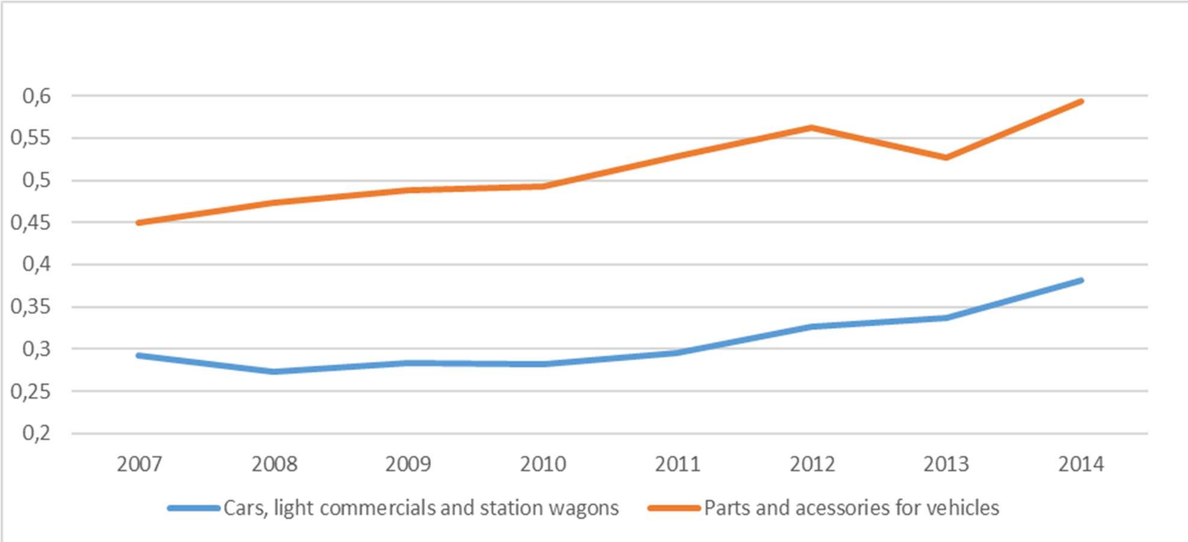
Figure 15. Labor Costs



Data Source: PIA (Pesquisa Industrial Anual) - IBGE

Labor costs in the automotive sector did not fall as production, thus putting pressure on margins. In fact, they rose for cars and light commercials. These movements can be better pictured looking at Unit Labor Costs (calculated as the ratio between total labor costs and the value of industrial transformation), as depicted in figure 16. According to this measure, between 2011 -2014 automakers faced an increase of 29% in its ULCs, while auto parts producers faced an increase of 12%.

Figure 16. Unit Labor Costs (ratio of labor costs and value of industrial transformation)

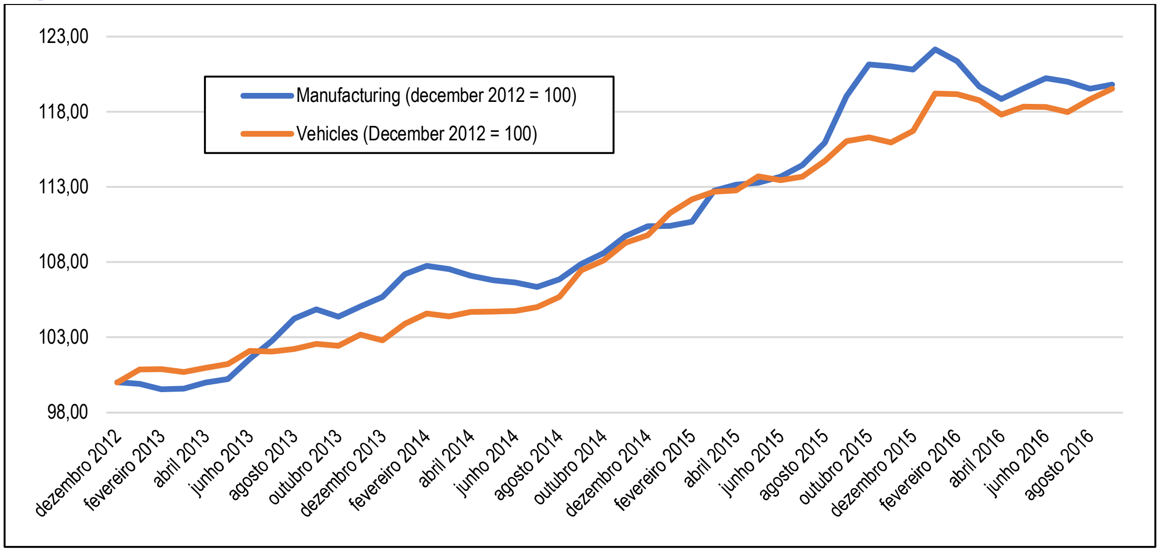


Data Source: PIA (Pesquisa Industrial Anual) - IBGE

Vehicles' prices did increase after Inovar Auto, but in line with the overall manufacturing prices (

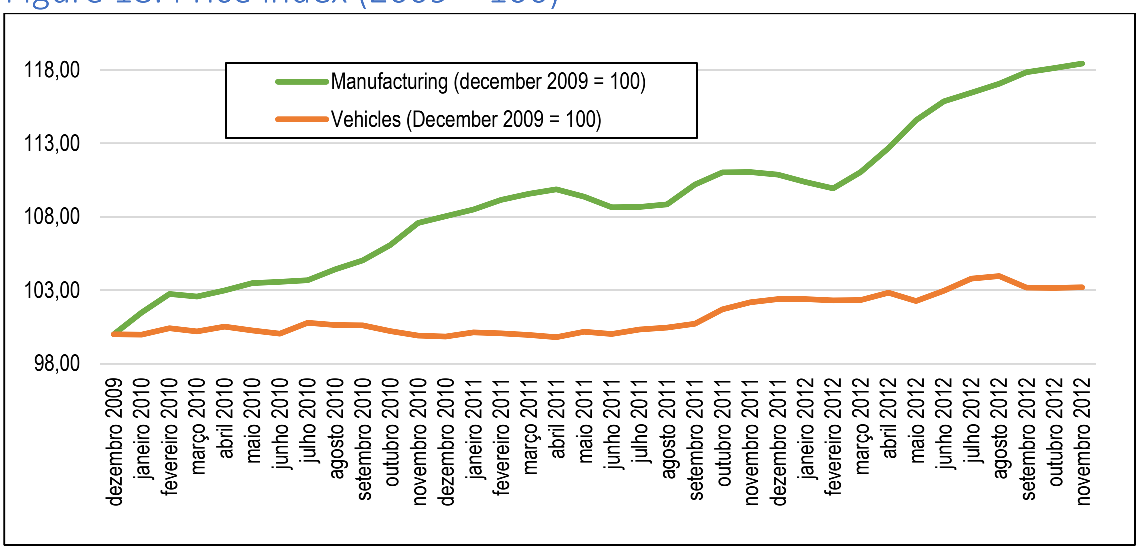
Figure 17). However, if we take into consideration that prices for vehicles had been relatively stable at least since 2009 (figure 18), Inovar Auto appears to have had a clear impact, allowing domestic automakers to increase their prices, as competition from imports was reduced.

Figure 17. Price index (2012 = 100)



Source: IBGE - IPP (Price Index to Producers)

Figure 18. Price index (2009 = 100)



Source: IBGE - IPP (Price Index to Producers)

Table 2 introduces three measures to provide a better understanding of the degree of competition in the market and also about the recent evolution of average production scale. The Herfindahl-Hirschman (HHI) and the C4 indexes are measures of concentration in a market, allowing us to make some inferences about the intensity of competition. The HHI is the sum of the squared market-shares of all participants, while the C4 is simply the sum of the four biggest market-shares in the market under study:

$$HHI = \sum_{i=1}^{n} p^2$$

$$C4 = p_1 + p_2 + p_3 + p_4$$

The United States Department of Justice considers that a market with a HHI under 1,500 is competitive, while for a result between 1,500 and 2,500 the market would be moderately concentrated.

For scale, we used production per firm, instead of production per plant, because we assume that strategic decisions by firms in how they allocate their production across plants is optimal. Furthermore, our calculations of concentration indexes and average scale take into consideration only the 12 biggest firms that produce cars, and the numbers include only passenger and light commercial vehicles. Among car producers, the selection of the biggest 12 allow us to exclude the small "luxury" producers such as Mercedes, BMW and Audi (as their required scale levels are probably smaller, as they are “niche" suppliers in Brazil).

Table 5. Production of cars and light commercial vehicles by the top 12 manufacturers in Brazil

Year	C4	HHI	Average production per automaker (units)
2007	84,98%	2,049	233,186
2008	82,91%	1,972	248,248
2009	83,50%	1,975	251,004
2010	83,50%	2,002	283,288
2011	79,78%	1,853	264,037
2012	78,67%	1,833	272,652

2013	72,15%	1,539	292,424
2014	70,01%	1,495	250,067
2015	63,74%	1,298	195,747

Data source: Anuario Anfavea 2016.

Data for the Brazil's 12 biggest automakers show that concentration is falling. The Brazilian domestic market became less concentrated since 2011 and this trend has been accelerating, suggesting that Inovar Auto might have increased competition in the domestic market. This is a fair hypothesis, as the policy attracted not only new players, but also new investments from existing producers, increasing the availability of new models, for example. This increase in competition is potentially beneficial for the consumer, although data on prices showed that prices did not fall, but rather increased. Two potential explanations are that imports are more important than domestic competition as a price-setter; and/or that production costs were higher.

Regarding average scale of production, the picture is less clear. Average scale, measured as production per automaker, did not show a clear trend, especially if we take into consideration that total production in 2015 was drastically reduced by the recent crisis.

The effort in terms of R&D can be assessed through the comparison of the two most recent and comprehensive national surveys on the subject: Pintec 2011 (covering investments from 2009 to 2011) and Pintec 2014 (released in December 2016, and covering investments from 2012 to 2014). As can be seen from table 6, the absolute number and the percentage of automakers that implemented innovation increased slightly (7% and 5% respectively). On the other hand, the absolute number and the percentage of auto parts producers that implemented innovation increased substantially (23% and 34% respectively).

Table 6. Number of Firms that Implemented Product or Process Innovation

Sector (CNAE 2.0)	2009-2011	2012-2014	Change

	Number of firms	Percentage of total	Number of firms	Percentage of total	In number of firms	In percentage of total
Vehicle manufacturing	27	75%	29	79%	7%	5%
Autoparts	581	34%	716	46%	23%	34%

Source: IBGE, Innovation Surveys of 2011 and 2014 (Pintec 2011 and Pintec 2014)

Table 7. Expenditures in Innovative Activities

Sector (CNAE 2.0)	2 011			2 014			Change		
	Total expenditures (R$)	Internal R&D (R$)	% of internal R&D	Total expenditures (R$)	Internal R&D (R$)	% of internal R&D	Total expenditures (R$)	Internal R&D (R$)	% of internal R&D
Vehicle mfg.	4,772,018	2,372,089	50%	3,694,765	1,907,944	52%	-23%	-20%	4%
Autoparts	1,792,668	921,607	51%	2,338,596	874,895	37%	30%	-5%	-27%
Total:	6,564,686	3,293,696	50%	6,033,361	2,782,839	46%	-8%	-16%	-8%

Note: Incurred by firms that implemented a new or substantially improved product or process. Source: IBGE, Innovation Surveys of 2011 and 2014 (Pintec 2011 and Pintec 2014)

Table 7 shows that the total expenditure in R&D activities[84] decreased substantially (-23%), and internal R&D also decreased substantially (-20%). On the other hand, total expenditures by auto parts producers increased substantially (30%), although internal R&D decreased slightly (-5%).

In sum, there was a small increase in the number of automakers innovating, but those who innovated spent substantially less on innovation and on internal R&D. On the other hand, there was a substantial increase in the numbers of auto parts producers innovating and in the amount spent by these firms, even with a small decrease in internal R&D. Comparing 2011 with 2014, automakers spent less on innovation, while auto parts producers spent more. However, there was a reduction in innovation expenditures overall.

4.4 EMBRAER INSIGHTS AND COMPARISON

It is interesting to compare Brazil`s automotive sector with the country`s far more successful production of aircraft, centred on the company Embraer.

According to the Embraer website (http://www.embraer.com/br/essencia), the company history started in 1946, with the strategic plans for a domestic aeronautical sector. In 1947/1950 there was the building of “Centro Tecnico Aeroespacial” (CTA) and the “Instituto Tecnológico de Aeronáutica” (ITA), in Sao Paulo, to offer aeronautical engineering degrees, previously offered only in Rio de Janeiro. Only in 1968 is that the first prototype of a twin-engine 20 passenger plane, the “Bandeirantes” was conceived, and the company was officially founded in 1969, as a state-owned firm, when it started to produce the tion of Embraer, as a state-owned company, to produce the “Bandeirantes”, and, from 1971, the military “Xavante”, under licence of the Italian Aermacchi. In 1977: the firm presented the first plane 100% designed by Embraer, the “Xingu”. Several new planes started production after that: “Tucano”, a

[84] Taking into consideration only those who innovated.

training military plane, in 1979, the civilian “Brasilia”, in 1980, and the military jet AMX, in partnership with the Italian Aeritalia, in 1985, with a total of 200 jets produced. In 1994 Embraer was privatized. Then, the launches of regional jets characterized the company`s strategy: between 1997 and 1999 several regional jets, ranging from 70 to 118 passengers, were produced. In the 2000`s new regional jets and executive jets (Phenon, Legacy, Lineage) were added to the company portfolio. In 2009 there as the start of the development of the KC 390, a military cargo aircraft, with first flight in 2015, and in 2016 Embraer launched a new generation of commercial jets.

Differences between Embraer and the Brazilian automotive sector

Analysing the Brazilian automotive sector and Embraer, with the aid of the literature, and specialized and institutional websites (Fonseca, 2012; Embraer web site, Ferreira and Salermo, 2011; Bastos, 2006; Mansueto`s blog; and Invest in Sao Paulo website) we can identify some differences that may partially explain why the Brazilian aircraft sector became more competitive than its vehicle sector.

First difference: focus on exports.

The company was established in 1969 as a state-owned firm and since its start it focused on the export market. In 2011 the company opened a factory in the USA, and in 2012 in Portugal. The domestic market accounts for roughly 10%-20% of Embraer`s production.

Second difference: Investments in R&D and partnerships with foreign suppliers.

To be able to export the company invested heavily in R&D, and in many cases had the support of partnerships with suppliers.

Third difference: labour costs are lesser than its main competitors

The labour costs in US dollars are smaller than those faced by Boeing, Bombardier and Airbus. However, China is a threat to this competitive advantage.

The firm was privatized in 1994 and faced a process of restructuring that contributed to large gains in competitiveness.

Fourth difference: Strategic advantages towards suppliers and dominance of key design capabilities

Embraer is very efficient in designing and assembling its products, but its competitiveness is due also to the vast share of partnerships with world leaders' suppliers in their fields. The strategic advantage of Embraer in its relations with its suppliers is that Embraer have the capability to substitute suppliers, as it has the capability to alter designs, projects and to produce some parts.

Fifth difference: it does not need to incur in transportation costs

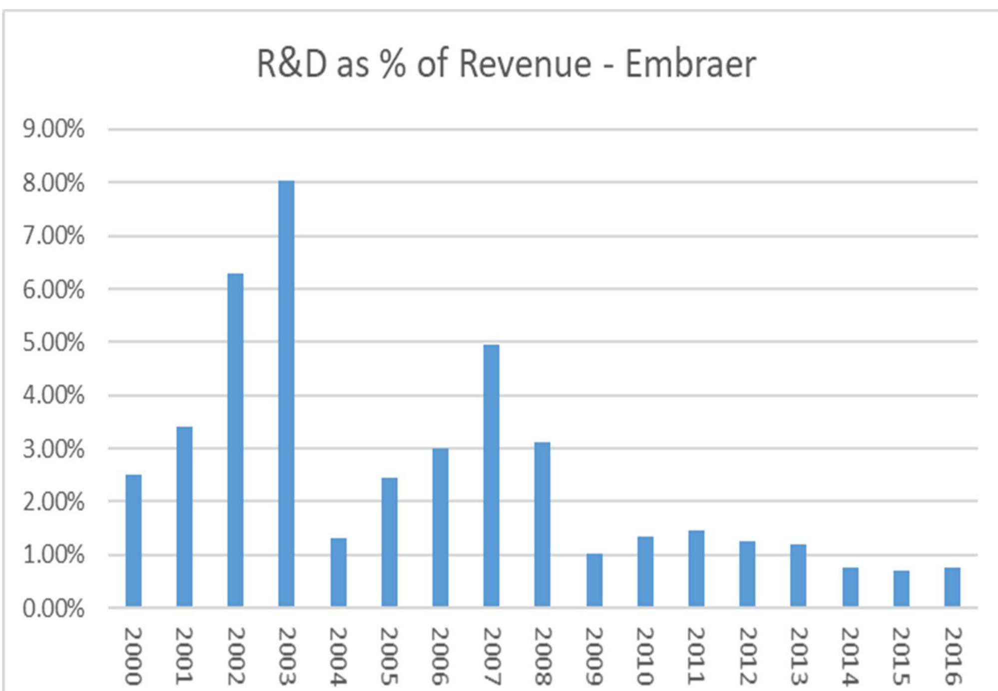
As the factory is close to its main domestic suppliers, in an aeronautical cluster in Sao Jose dos Campos/SP, Embraer`s suppliers producing domestically do not face the transportation costs faced by automakers` around Brazil. Some imports are also relatively cheap to transport, as the ones that come by ship arrive through Brazils` main port, relatively close to its factory. But the most important aspect regarding infrastructure is that the products Embraer exports fly directly to its clients.

A sixth difference would be that Embraer is Brazilian owned. However, this is not necessarily a reason for substantial differences in terms of outcome and performance, as there are international investors owning shares of Embraer and the company is run like most private defence firms around the world: seeking efficiency but relying on public contracts. Moreover, some of the car manufactures in Brazil are in fact Brazilian firms, producing cars under licence of a multinational that owns the brand – such as, for example, CAOA group, that produces Hyundai and Cherry models.

The start of Embraer was possible given a combination of public money and resources and strategic partnerships. Later, after privatization, its success was based on access to imported goods, and more partnerships. It is not straightforward to replicate these conditions for other sectors, but the main lessons could be applied: investments in R&D as public goods to be used to a wider number of sectors and companies, and access to imported inputs could be essential.

Embraer has more than 4,000 engineers working with R&D. This emphasis in R&D was crucial for the company success. Although very high in comparison with the domestic operations of the automakers operating in Brazil, the investment in R&D is not too far from the levels seen in the headquarters of the main automakers. However, the examination of the company`s financial statements allow us to see that the investment in R&D is showing a declining trend from the average between 2000 and 20008 and the average between 2008 and 2016 (figure 19). This could be the result of the conditions faced after the financial crisis of 2008, or due to the fact that R&D is increasingly made by suppliers, also in the aircraft sector. However, if we compare the latest figures with the percentage of revenues that is invested in R&D by the 10 biggest aircraft and defence manufacturers that have production plants in the UK, it is clear that Embraer is reducing its investments in R&D: These investments in 2016 ranged from 2.1% of sales for Lockheed Martin, to 9.1% for Bombardier. The average of the 10 biggest was 4.6% of sales invested in R&D (The Aerospace Technology Institute, 2018).

Figure 19 – R&D as a percentage of revenue



Source: Income statements: http://ri.embraer.com.br/

Suppliers can take a fundamental role in the development of new products, alongside the producers of the final goods. However, for this cooperative system to work well, the producers need to efficiently coordinate all suppliers and activities to generate innovations and improvements in products and processes. Ferreira and Salerno (2011) says that the Brazilian aeronautical industry is an example of successful partnerships.

A special type of partnership is the one where all parts share financial risks and rewards (Bastos, 2006). There are, however, variations in terms of how dependant is the assembler from the suppliers: if the assemblers can easily or not change suppliers if they do not deliver as expected. There is also variation in terms of who coordinates each process. (Ferreira and Salerno (2011))

Within Embraer, some of its suppliers are partners with technical and financial stakes in the development of the products. There are, however, “regular” suppliers, that just sell their intermediate goods. Embraer has gained bargaining power with its suppliers thanks to its dominant position in the market. In some products, Embraer opts for a verticalization process, for different reasons: in the case of the Phenon, the firm decided to produce more parts internally in order to accelerate the launch. In the case of the Legacy, the firm wanted to master some technologies and also use some of tax benefits to produce in its plant in Portugal (Ferreira and Salerno, 2011)

There is some modularity in aerospace, as in the automotive sector, but given the complexity of the sector, the assembler always needs to coordinate everything (Ferreira and Salerno, 2011)

The “custo-brazil” affects Embraer to a lesser extent than it affects other sectors, but it still has an effect. From the demand side, roughly 10-20% of Embraer`s sales are to domestic buyers. From the supply side, the potential bottlenecks for gains in competitiveness are somehow under control: labour costs; labour qualification, exchange rate and transport infrastructure. As said, these are to some extent smaller problems given the reasons explained in this chapter. Moreover, most of them have been addressed: On top of the specialized and highly respected aeronautical engineering university ITA – "*Instituto Tecnologico de Aeronautica*", Embraer has set up, since 2001, specific graduate programs of aeronautical engineering, having already graduated more than 1,500 engineers. Exchange rate is a crucial component for Embraer profits, but the company has natural hedge, as most of its components are imported and most of its sales are in foreign currency.

The main differences between Embraer and most of the Brazilian industrial sector is that the aeronautical company can buy the best inputs in the world, at almost no extra cost (this is due to the tariff suspensions of inputs, that are then exempted after the final good – the plane – is exported) and the lower susceptibility to part of the Brazilian business environment.

All aeronautical companies in Brazil benefit from a "suspension" of import taxes and IPI-import taxes. This means that they can import intermediate goods without paying those taxes, provided that later on the final goods are exported. If they do not export, the firm needs to pay those suspended taxes. It is a drawback regime, very common in other sectors and countries – and indeed used by the automotive sector as well. One difference is that in the case of the aeronautical industry the system is also fully automatic since 2002: the imported goods can go directly to the manufacturing plant in Brazil, without the need to pass through customs control. As the customs process in Brazil is very slow and costly, this measure solves one of the biggest bottlenecks in Brazilian ports. This system, called "Regime Aduaneiro Especial de Entreposto Industrial sob Controle Informatizado (Recof Aeronautico)[85]"

Investe Sao Paulo (2009) indicate that the local content of Embraer in 2009 was very low (around 5%). In this sense, it is as if Embraer is an assembler that adds value in design, coordination of process, and labour, but that does not create a dense domestic supply chain. The firm uses a logistic center in Taubate to keep all supplies it needs, and then deliver them "just in time" to the manufacturing plant. Most (75%) of its

[85] This supports mainly the biggest aeronautical Brazilian companies - Embraer and Helibras (helicopters), but there are similar systems for other sectors.

exports and imports, in terms of value, are done by air. In terms of weight, 70% is done by maritime transportation.

The cluster in São Paulo

According to the Survey “Relação Anual de Informações Sociais” (Rais), collected by the Brazilian Labour Ministry, in 2016 there were 83 companies manufacturing aircrafts and parts, located within Sao Paulo. Minas Gerais has the second position among the Brazilian sates, both in terms of number of firms and employment in the sector. This is due to the presence of Helibras, a helicopter manufacturer.

According to the “Invest in Sao Paulo” state agency, there is an aeronautical cluster in Sao Jose dos Campos, with Embraer as the main company. The aerospatial cluster is located in the São José dos Campos` technological park (PqTec) and comprises over 100 technology-based enterprises in 188 thousand square meters. Firms that are part of this cluster have many benefits, such as support for participation in international trade fairs and trade missions, setting up of consortia, technical certifications, training, infrastructure, partnerships and subsidies from governmental institutions like Finep, APEX, ABDI, Sebrae, SDECTI/SP and BNDES, and with other clusters in Canada, Sweden, England, Netherlands, and China.

The cluster also benefits from the proximity to the Aeronautical Technology Institute (ITA), created in 1950. In its campus, the institute offers graduate and post-graduate (masters and PhDs) degrees in engineering (in 28 different areas, related to aeronautics, aerospatial, electronics, mechanics and physics. In 2017 ITA had 2,400 students and 180 professors. Moreover, in the city there is also a facility of the National Institute for Space Research (Inpe), and agency part of the Ministry of Science and Technology.

Other research centers that contribute to the cluster are the “Laboratório de Estruturas Leves (LEL)”, part of the “Centro de pesquisas ligado ao Instituto de Pesquisas Tecnológicas (IPT)”[86], from the São Paulo State government; the “Departamento de

[86] Created in 1889.

Ciência e Tecnologia Aeroespacial (CTA), part of the Brazilian airforce; the "Instituto de Aeronáutica e Espaço (IAE)"; the "Instituto de Estudos Avançados (IEAv)"; the "Instituto de Fomento e Coordenação Industrial (IFI)", to supply certifications; and the "Instituto de Pesquisas e Ensaios em Voo (Ipev)".

Industrial policies should aim to increase productivity or innovation, the drivers of economic growth, and not to protect vested interests. A good example of good industrial policy is what was done with Embraer. But that is hard to be replicable. There are others in Brazil, as, for example, Petrobras, Vale, Embrapa, etc, with different degrees of initial difficulties, different degrees of scope and type of instruments, and different degrees of success.

Mansueto Almeida, in his blog, said, in 4/January/2012, that he received a reply from a former Embraer CEO, Ozires Silva, after he made a comment about the company. The comment made by Mansueto was that the company survived in its early days thanks to the support of the Government. The reply, however, stated that although initially a state-owned enterprise, Embraer was always managed as if it was a private company. In this sense, and against all odds, it proved itself in the market and it can be considered a success case, for all metrics.

CONCLUSIONS

Although for most of the 20th century the automotive sector was one of the most important industries worldwide, its future importance to development and developed countries alike has been questioned, as the industry is seen as "old" and "dying" in face of new technologies and behaviour patterns, such as shared vehicles (potentially reducing demand for cars), for example. Partly because of sharper demand limitations in developed countries, and partly because of cost-issues, vehicle manufacturing has been moving to developing countries. However, among these, the bigger and more integrated Asian economies seem to receive the bulk of new investments.

In the past, all Brazilian automotive industrial policies since the 1950s have made use of protectionism, within the import-substitution framework. Moreover, domestic content[87] ensured that the policy benefits reached not only the automakers, but also the auto parts producers. The level of import barriers erected was – and still is – quite high. Exports were used only to compensate for periods of low domestic demand, as since its conception, the industry always focused on the domestic market. All in all, although the previous policies were the drivers for the relatively successful attraction of FDI into the Brazilian automotive sector[88], they generated serious shortcomings in terms of competitiveness for the sector. Because the scale of production was limited to the size of the domestic market, and fragmented among many automakers, productivity was compromised. In addition, without a more export-oriented approach, and within a very protected market, there was less competition from abroad and less incentives to produce better vehicles. Although the automakers in Brazil are multinationals, and therefore part of GVCs, their domestic production was inferior in terms of quality and has a higher price tag than what could be seen in the international markets.

Protectionism was used as a tool to attract FDI in all policies, but besides that, for the 1950s and the 1990s the intention was also to avoid trade deficits, while for Inovar the additional motivation was also to protect domestic producers from losing market-share to imports. Finally, Inovar Auto added R&D and fuel efficiency targets. None of the three policies directly promoted exports.

The automotive industry in Brazil is then facing a double risk: being uncompetitive given the highly protected domestic market and the high costs of producing domestically ("custo-Brazil"), and being an industry facing existential threats worldwide. As pointed out before, scale gains are necessary, and exports seem to be

[87] The local content requirements and protection were higher in the 1950s, as the industry was in its infancy. For the "Regime" of 1995-1996 as for Inovar Auto of 2012, the local content requirements were smaller, although explicitly 60% in the 1995 Regime, and implicitly around this percentage for Inovar Auto. Furthermore, protection in the 1995 and 2012 policies were similar.

[88] The literature suggests that the Target Plan of the 50s did play a decisive role in attracting investment, but the following policies of the 1990s and 2010s had a less clear impact: investment was increasing before these policies were set up and thus policy could have had only a partial role in the results.

the logical way forward, together with easier access to imported inputs and a better business environment.

Many studies tried to estimate the minimum efficient scale for the automotive sector. As Natsuda, Otsuka and Thoburn (2015) summarizes, the optimal scale for some autoparts, such as engines, is larger than for producing vehicles itself. The authors also argue that, given the consolidation of the industry in large conglomerates, the minimum efficient scale per plant was probably reduced to 150 thousand vehicles per year (although, still according the studies surveyed by Natsuda, Otsuka and Thoburn (2015)[89], the minimum size of production to achieve efficiency could be as low as 30 thousand vehicles, if assembled as CKD (completely knocked-down)). Nonetheless, the authors support that the minimum efficient size of firms has increased, reaching something around 5 million vehicles, in the case of mass-market models, and around 1 million in the case of luxury brands.

Moreover, the location of automaker`s plants can hide important information about investments and trade, as an increasing part of the value-added is traded between subsidiaries of those automakers worldwide and also between autopart suppliers and their automaker buyers located in different countries. These global value chains are one of the main characteristics of the global automotive industry[90]. Participation in GVCs as an exporter implies a need for cost-competitiveness, and this is more easily achieved in more liberalized countries, where imports of intermediates and capital goods help to boost export competitiveness, or at least in countries with sufficient trade agreements to boost export competitiveness and market access. The contrast with ISI policies pushes us to the debate between specialization versus diversification, as a development strategy.

As explained in the previous sections, domestic demand is among the key advantages of Brazilian manufactures, and it was the main attraction for multinational automakers since the 50s. However, domestic demand is not solely a function of population, as income level and distribution, economic growth, domestic integration, general

[89] Nolan (2012).

[90] The importance of these GVCs varies according to the type of product and its location in the value-chain, with estimates pointing to around 50% of autoparts being outsourced worldwide (Rudolf Traub-Merz, 2017).

business environment and trade and industrial policies all impact the potential for domestic vehicle sales and production. However, exports remain a key variable, in a world characterized by monopolistic competition among globalized automakers.

The domestic market is simply not enough anymore to guarantee the required scale of production. Although Brazil is a major market for motor vehicles[91], and has been able to incentivize the multinationals to establish production in the country, recent data point to an exhaustion of this inward-looking model. The last industrial policy for the sector, for example, did not promote exports (as neither did the previous policies), and had mixed results: a) it reduced competition from Chinese imports (firms not yet producing in Brazil), while allowing for imports from the firms with production in the country; b) it probably contributed to only half of the new investments seen after the launch of the Program; c) the policy did not increase overall R&D in the sector; d) it did not increase scale of production.

CHAPTER 5 – QUALITATIVE DATA AND ANALYSIS

In this chapter we explore qualitative data gathered from interviews, to gain insights on the relationships between trade-related barriers and industrial competitiveness within the Brazilian automotive sector. Following the methodology established in the previous chapter, we will use thematic analysis as a method to help us to classify and critically interpret the results of the interviews, comparing those results to the literature, and taking into consideration the context of the case study. The outcome of this analysis is then a list of insights.

[91] The motor vehicle sector is a large employer in Brazil's manufacturing sector.

Building on the theoretical empirical linkages identified from our literature review, we developed the following thematic blocks to guide our data collection during interviews, and to organize our interpretation efforts:

BLOCK “A”
Internal + external economies of scale
Comparative advantages
Location and investment decisions based on scale
Local content requirements (domestic diversification) x Global Value Chains (specialization)

BLOCK “B”
Foreign and domestic competition
X-efficiency
Markups
Firm heterogeneity and changes in market-share
Competition and Innovation
Resource allocation (inter and intra-sectoral)

BLOCK “C”

Technologial spillovers
Access to imported inputs
Lessons from Embraer

BLOCK "D"
Business environment, institutions, regulations and industrial policies (including Inovar-Auto and R&D policies)
Location and investment decisions based on the business environment
New technologies
Income levels and quality of labour
Current firm-level productivity

In the first subsection – Results from Interviews - we describe the findings that emerged from the transcripts. Initially, this description is done in the most neutral way possible, without any value judgement or critique. For the description we first highlight the similarities – or eventually the consensus – and then we highlight the differences, pointing to its sources in terms of origin of the interviewee. Quotations are used both to clarify and to allow for further interpretation. In the second subsection – Interpretation/Analysis - we interpret the partial results found in the previous subsection, contrasting them to the literature and establishing potential connections among each partial result. The subsection ends with a list of insights generated from this analysis.

5.1 - RESULTS FROM INTERVIEWS – PARTIAL FINDINGS

OVERALL INSIGHTS

The results from our interviews point to a general acceptance that the levels of protection faced by the Brazilian manufacturing sector in general, and the automotive sector in particular, need to be reduced. However, it was also exhaustively mentioned that before tariff reductions, it is necessary to improve domestic competitiveness conditions.

During the interviews we asked about the consequences that two opposite strategies – higher and lower trade protection – could have on the scale of domestic production, on the productivity of domestic firms, and on the allocative efficiency within the domestic economy. The findings indicate that the levels of trade protection enjoyed by the Brazilian automotive sector are still too high and could be compromising the long-term competitiveness of the sector. But the interviews also indicate that without proper polices and reforms in the Brazilian business environment and institutions, the auto sector and most of the manufacturing sector would suffer severely from a full trade liberalization.

We then have apparently contradictory results here: trade protection is damaging competitiveness, but in order to reduce it, it is necessary first to improve competitiveness?

Although it was a near-consensus that lower overall trade protection could improve Brazilian industry competitiveness, it was very debatable under what conditions, how, and to what extent, this trade liberalization should happen: most answers point to a gradual liberalization, mainly through regional trade agreements, with some answers explicitly pointing to the need of a *pari-passu* reduction of "*custo-Brasil*":

"Trade openness is necessary to increase competitiveness. An important question is what type of trade openness. The industry believes that the best path is a gradual and negotiated process, through trade agreements. This would allow predictability, time for adjustments, and better terms to access foreign markets. The most important trade

agreement to date to be signed is the one with the European Union. Besides this, other important agreements under negotiation are Mexico; United States and Japan. Mercosur needs to be renegotiated as well, to rationalize the TEC[92]*.. reducing tariffs for inputs and capital goods, increasing tariff escalation... The industry in general, including the automotive sector, does not support a unilateral tariff reduction" (Industry Association)*

"An abrupt trade liberalization is not the solution. If the country does it, it would end up like Australia: without an automotive industry. It is very difficult to compete with China and other countries that have much lower production costs". (Automaker)

" Tariffs are not so important compared to other variables. We would be happy to dropout the 35% import tariff alongside competitiveness gains" (Industry automaker).

Some answers, however, were more vocal on the benefits of even a unilateral trade liberalization:

"With complete trade liberalization we risk turning ourselves into Australia. But, is this bad?" (Industry supplier tier1).

The respondents that argued for a faster and deeper trade liberalization were those who would be under a lower risk of eventually loosing from that, either because they are firms already very internationalized or because they are not from the industry, but academics or policymakers. On the other hand, the discourse for a more careful trade liberalization had more echoes in firms from within the industry. One of these firms, for example, added that protection is necessary not only to compensate for cost-disadvantages, but also to avoid trade deficits:

"Trade balance deficits trigger protectionist policies, and, in the case of the automotive industry, there are currently 12 protectionist programs around the world". (Industry automaker).

[92] Acronym in Portuguese for "Common External Tariff", applied by Mercosur countries against imports from outside the bloc.

Respondents from the suppliers defended that protection levels are not that high, and that there is competition in the domestic market. For these interviewees, the focus on exports is necessary, but this does not mean that there should be intense trade liberalization:

"To increase competitiveness, we do not need more competition, as the mark-up in the domestic market is similar to the one verified in foreign markets". (…) "The shelter against imports for autoparts is around 25% (+- 16% import tariff and +- 9% logistic costs)" (Industry supplier tier 1)

The move to a more liberalized economy would face opposition by manufacturing firms based on decades under heavy protection, despite the trade liberalization of the 90s. There were those who pointed to the existence of an equilibrium with trade protection among the Brazilian industry. One respondent said that Brazilian firms got used to this and count on this to survive:

"Firms in Brazil want protection. They do not focus on long term competitiveness without protection". (Academic)

Another insight is regarding the heterogeneity within the autopart producers in the Brazilian automotive sector:

"We have good domestic companies, producing top notch autoparts… they are global players, very innovative and competitive, and were able to achieve this despite Brazil…usually setting operations abroad or just searching to increase exports…but these are not the norm…the norm is a tier3 or 4 "surviving" business, that in the past made some nice profits, but now is just surviving." (Industry association)

There were suggestions that the overall effects, both from the business environment and "custo-Brazil", and also from the inefficiencies related to entry and exit barriers, and from the general extra cost imposed on imports, impacts all economic sectors, not only directly, but also indirectly, making all production factors more expensive, especially labour.

“*Workers spend hours in congested public transport to get to and from their workplace. And compromise big chunks of their salaries to pay for overpriced goods*” (Government).

Confronted with a series of questions that included all the themes presented in his answers, one small autopart producer gave a detailed account on how different aspects are inter-related and combined to negatively affect competitiveness: He said that what explains the low competitiveness is a combination of custo-brasil and low average scale. And this low average scale would be a result of both low overall scale and an excessive number of smaller firms. The low overall scale would then be a result of the low income in the domestic market, while the excessive number of smaller firms a result of cultural aspects (family-owned firms) and institutional aspects (tax law and other regulations disincentivising growth; and labour liabilities that are a disincentive to the sale of firms.

BLOCK “A”

There is a consensus that higher scale is paramount to be competitive:

“When you have scale in production you can bring technology and investment” (Government).

“Scale is paramount, and maybe the only way for Brazil to be in the global markets” (Industry automaker).

“Multinational firms decide to invest in another country based on a combination of: the size of the market; the availability of good and cheap production factors, such as

labour; the level of protection; and the government incentives; usually in this order of importance. (…) Usually, a multinational follows the rule of "one product, one place", in order to extract the maximum in terms of scale gains". (ABEIFA Association)
Note: he did not mention any strategical aspect in the investment decision, such as search for market-share; securing supply chain; increase of brand recognition; technology absorption.

Some even suggested that scale – and logistic costs - dwarf tariff structure as a driver for competitiveness:

"Scale and logistic costs are very important factors in the decision to import or produce locally. The nominal tariff, however, is not". (Industry automaker)

It was remembered that Tier-1 suppliers are located where automakers are located. Thus, the evaluation of having or not enough scale usually applies similarly to both automakers and Tier-1 autopart firms:

"Nobody imports complete systems. So, having automakers implies having tier-1 firms". (Government)

"Bosch, for example, import its parts, assemble and deliver to automakers. It competes with other Bosch plants around the world. Tier-1 suppliers have systems to collect prices and bid from suppliers around the world". (Government)

"the automakers make their own engines, except for trucks, who outsource this". (Government)

An automaker listed the necessary conditions to be competitive in foreign markets, synthesizing most of the responses from interviews on these topics:

"Competitiveness is the key word. First, we need to have competitiveness to compete within the domestic market (against imports and among the domestic producers). Then we need to have competitiveness to compete in foreign markets. The main bottlenecks for the Brazilian automotive sector competitiveness are: a) high taxation, which is part

of Custo-brazil, and means that 33% of the revenue goes to the Government; b) there is no proper financing, that means it is very costly for consumers to buy in instalments, and thus demand is lower than what it could be (this is also part of "custo-Brasil"); c) the lack of scale, especially for better and most expensive vehicles: the purchase power of the Brazilian consumer is very low. They can only buy very simple vehicles; d) there is not enough long-term planning by the firms, because there are not credible long-term policies. Without this, it is impossible to plan properly and therefore there is less efficiency and competitiveness". (automaker)

Some specific mentions about how the low-income level and infrastructure deficiencies contribute to lower scale in Brazil:

"Logistic costs and infrastructure difficulties make productive integration within the domestic market more difficult in Brazil. Therefore, production should be even more concentrated than it is now". (Automaker)

"Income is very concentrated…this affects the potential scale of the domestic market" (Autopart producer).

When discussing if the Brazilian automotive sector has enough scale to be competitive in foreign markets, answers pointed to the need of more specialization around specific types of products:

Brazil has not scale for medium-sized and large vehicles. We should open up the market for these segments, as well for some inputs. (Automaker)

"The size of the Brazilian market did not justify the local production of Volvo cars, even with Inovar-Auto. The decisions made by BMW and Audi were made on an unrealistic demand projection, and also on the assumption that high levels of protection would prevail". (ABEIFA ASSOCIATION)

"Brazil has no comparative advantage for vehicle production. It is not close to any important consumer centre; it has not cheap labour; it has not low energy costs; and its domestic market is only big enough for cheaper vehicles – given the income level

of the population – and for pick-ups – given the agroindustrial economy". (Automaker with low scale).

The same interviewee gave examples of investments made by automakers with lower scale, explaining that the rationale of these investments is to sell not only to the domestic market, but also to Mercosur and other South American markets.

Others emphasize that firms should face a combination of better local suppliers and lower protection, to increase specialization and competitiveness, as there are advantages in having a domestic supply base:

"Because they stamp, automakers buy more steel than autopart firms. One of the problems regarding this material is that there are no long-term contracts… they should have a cooperative buying process, to buy in larger scale". (Government)

"The cost of steel is a problem. There are partnerships, but not many and not enough". (Industry automaker)

"To be competitive, some inputs need to be produced domestically". (Government)

Besides the need of having a domestic supply base, answers pointed to the need to tap on imports of autoparts not efficiently produced in the country:

"For some electronic components there are only two suppliers in the world: There is no domestic scale even to "scratch" this". (Government)

"Specialization can generate the necessary scale". (…) "Access to technology via imported inputs is important". (Industry supplier tier 1)

The discussion regarding how much inputs to import could be framed as a discussion about the optimal local content. This is viewed as a major discussion, complementary to the discussion related to scale. In this sense, some respondents explained that scale dictates the "natural local content":

"There is an ongoing debate, among industry associations, between the pros and cons of local content policies versus specialization". (Industry association)

"The costs of local content are a result of scale: Honda, with lower scale, needs to have a lower local content" (…) "The natural local content is defined by scale" (Government)

"Local content was applied in Inovar Auto based on ideological premises, not sound theory or robust empirical evidence". (Government)

"The natural local content within the Brazilian automakers is around 75%-80% for the 4 biggest producers in Brazil, 60-65% for the medium-sized producers arriving in the 90s, such as Renault, and 45%-50% for the Japanese producers that arrived later on, such as Honda and Toyota. These values are in terms of value of domestically produced parts/ total value of parts, for 2012". (Government)

"Honda, Toyota and Hyundai have lower local content than the most traditional automakers established in Brazil. As the traditional automakers - Ford, GM, Fiat and Volkswagen - lost market-share recently (thanks to the protection of the domestic market, and the consequent attraction of new players), so the autopart firms lost sales as well. This was a direct result from Inovar Auto, and it added to the overall demand fall. This difference in local content is due to two things: a) the time required for long-term relationships with domestic suppliers; b) the smaller scale of the newcomers justify a higher percentage of input imports (as the local autopart suppliers do not see economic viability in producing at so small scale for a specific automaker)". (Government)

"Domestic prices are high because there is not sufficient scale of production, and because machines and equipments are expensive". (Automaker with low scale)

Refining this perception, some respondents said that to increase scale there should be more trade integration and the industry should be more export oriented. Moreover, it was said that exports could be a source of technology upgrading, although this channel is seldom used by Brazilian firms. A more specialized and export-oriented economy is viewed as beneficial to increase scale in Brazil, but most of the respondents that said this also said that the most important consequence of an export-oriented market was to reduce domestic demand uncertainty:

"Low average scale is a consequence of protection" (Automaker with low scale)

"Scale is everything. Our firm is in Brazil because the market is relatively big, and we believe we need to accept the conditions of the market, but the local mind-set is heavily focused on the domestic market" (Industry supplier tier 1)

"The majority of Brazilian companies that invest abroad do this to access foreign markets. Only a minority do this to gain access to new management practices and new technologies. This minority is formed mainly by software, chemicals, and metal-mechanics, and they make use of the innovation structure existing in foreign countries. As examples of firms that improved management practices through foreign exposition, we have Coteminas and WEG. The third reason for investing abroad would be to be less exposed to the domestic business cycle". (Industry association)

"The internationalization of companies would be highly recommended to intensify the flow of knowledge". (Academic)

"Internationalization is necessary for the autopart sector. The recent crisis helped to forge this perception". (Industry association)

More integration into Global Value Chains or Global Production Networks is then viewed as a way to foster specialization, competitiveness, and scale, but respondents also express concerns regarding the size of the domestic supply base that would survive:

"Integrators, like Embraer, are becoming the norm in industrial sectors" (industry supplier tier 1)

"*The quest is how to engage more in Global Value Chains without turning into Mexico" (Industry Association).*

There is hesitation about the current degree of production density within domestic value chains, as some interviewees suspected imported inputs and assembling of final products are increasingly the norm within Brazilian industry in general:

"Machine manufacturers, such as Industrias Romi, who sell some machines and also some steel parts for the autopart sector, are in fact just assemblers, using a vast amount of imported inputs within their production line". (small autopart producer)

"Brazil only assemble cars, like in maquiladoras, it does not really innovate and does not produce the most value-added parts". (ABEIFA Association)

This last quote is from an association of importers; thus, it may carry an extra bias against trade barriers.

The need for a more export-driven mentality was also pervasive in some answers, as such:

"Brazilian domestic firms always looked to the rear-view mirror, as if the domestic market was sufficient to grant competitiveness and profitability forever". (Autopart producer).

"The domestic product is bad because there is low average scale per plant, and, for the few models produced with good scale, there are limitations in terms of quality and equipment – caused by the limited income of the consumers. Thus, with these vehicles, Brazil is not competitive as an export platform…there is no regulation pushing up their quality and equipment levels". (Government)

BLOCK "B"

Regarding the levels of both foreign and domestic competition, answers seems to point that domestic competition is higher than competition from abroad. Moreover, it seems that there is much more domestic competition among smaller firms, while foreign competition affects firms according to the sector where they operate (producers of low value-added goods seems to be more shielded from foreign competition). Finally, as foreign competition seems to be dependent on the levels of the exchange rate and tariffs, and as exchange rates fluctuates, pressure from foreign competition also fluctuates.

Too many small firms do not pay taxes, or do not comply with regulation, but are still competing for market-share. These small firms make the market very fragmented and as a result scale is down. (Small autopart producer).

"There are few imports of trailers, thanks to the transport costs of such low value-added good, and also because to import you need to go through some heavier bureaucracy, similar to the one applied to the import of regular vehicles". (small autopart producer)

"Lower value-added parts would be locally sourced anyway, even without tariffs, given transport costs and timing". (Automaker with low scale)

"Simpler imported cars are not competitive given the current exchange rates and tariff levels. The current imports are concentrated in more expensive vehicles". (ABEIFA Association)

"Imported cars, currently, have no power to influence the prices of domestic producers, either because of its market-share and because their prices are too high, given the factors already mentioned". (…) "However, in 2011, the volume and prices of imports indeed had the capacity to curb prices within the domestic market". (ABEIFA Association)

The low pressure from imports does not lead to reduced efficiency and innovation, as we have enough pressure from domestic competition. Moreover, firms in Brazil need to be very efficient in order to overcome "custo-brasil". (Automaker)

Some respondents defended that although higher levels of protection indeed reduce competition from imports, current protection levels do not allow for high mark-up levels. There were basically two explanations for this view: a) protection did not reduce competition between domestic firms, and the Brazilian automotive sector is a competitive market, according to them; b) protection just compensate for the high production costs, the high interest rates and the bad business environment in general, in Brazil:

"We (in Brazil) have plenty of automakers disputing the domestic market, by price and by product. You cannot charge too much…consumers have choices." (Automaker)

"The automakers are in a competitive market, and you can see this happening as they loose and gain market-share". (Industry association)

"If you consider all the costs incurred in producing in Brazil, the net profits barely compensate for those. Firms that internationalized and shifted part of their production to other countries are better off than firms that stayed completely in Brazil" (Autopart supplier).

Some respondents explicitly compared Brazilian operations with foreign counterparts, to illustrate their argument, while others provided an account of how profitability fluctuated within Brazil during the last 40 years:

"Mark-up levels of automakers in Brazil fluctuate a lot. Currently, some automakers are making loss in Brazil." (Government)

"Profits in Brazil fluctuate a lot. In short, automakers have around 4 years of high profits followed by around 4 years of losses, and then 4 years of high profits again, and losses again" (Academic).

Asked about the main determinants of this fluctuation the interviewee pointed to a combination of the costs and difficulties caused by "custo-Brazil", the intense consumer demand fluctuation ("booms" and "busts"), and the changes in industrial policies:

"When situation gets bad a policy is set up to help firms, but this help is usually exaggerated" (Academic).

However, specifically for smaller autopart suppliers profitability seems to be much more squeezed. It was said by some interviewees that lower tier autopart suppliers operate under intense competition within the domestic market, and also that they struggle to compete with imported autoparts, and have their margins squeezedby oligopolistic buyers (automakers and tier 1 autoparts) and suppliers (steel suppliers):

"The domestic competition among smaller suppliers barely allow any mark-up, while for tier-1 the margins are higher". (Industry association)

The interviewees usually pointed that most firms in Brazil invest in R&D just to escape competition. Just a few bigger firms invest in R&D to increase mark-up.

Some results also highlighted the difference in terms of competition intensity and public benefits between bigger and smaller firms:

"Competition in many cases is about who get the best regulatory advantage, or special treatment. And these are usually the big firms". (Autopart producer).

A more dynamic domestic market is suggested as important to raise productivity. But a more competitive and dynamic environment needs to use better technology, and this seems to be another bottleneck related to regulation and the business environment, as we shall see in the next block of insights:

"We need to help new entrants… to channel resources to better and more innovative uses…this is the only way to go forward if we do not want to lose the trip". (Academic)

“Internet connection is bad around here, and this is going to be a bigger issue in the next years, as 5G will be e reality in most advanced countries, bringing new possibilities” (Academic).

Regarding intrasectoral factor allocation, some responses cited that protection allows the surviving of inefficient firms. This argument, however, was disputed by others, who claimed that the excessive number of inefficient and small firms within the Brazilian autopart sector was caused by cultural and institutional factors, not necessarily affected by trade protection levels. A third group pointed to the combination of the cited causes:

“The excessive protection, together with institutional failures (law forcing that banks assume debts in cases of Mergers and acquisitions, for example) contributes to the existence of more small and family firms in Brazil, as they neither grow nor exit the market” (Industry supplier tier 1)

“Between 1997 and 2002, foreign firms acquired the best autopart suppliers in Brazil. Those who remained domestically owned, but that invested in professional management, became relatively successful. Those, however, who were family-owned and kept an amateurish management are surviving just because of protection and are mainly in the replacement market. What keeps them alive, despite a huge competition from Chinese suppliers, is the combination of protection with regulatory policies set up by Inmetro. Only a few of these family-owned suppliers still supply to Tier-2 or tier-1 firms, but are within low technology subsectors, such as forging and rubber parts. These subsectors are naturally more protected against foreign competition given the transport costs” (Industry association)

The following interviewees directly blame protection for allowing the survival of inefficient firms:

“The goal of trade liberalization is to free available resources to more productive uses, within and out of the original sectors, and allowing the Brazilian economy to cope with the technological transformations. This process involves firms dying.” (Industry supplier tier 1)

“There is not enough “creative destruction” within the Brazilian industrial sector: the "inefficient" is still there, disrupting the "efficient"”. (Industry association)

A smaller portion added the amateurish characteristic of smaller familiar firms in Brazil. Thus, despite most of the respondents saying that there are too many small firms in the market, the discussion regarding a potential general lack of managerial quality in Brazil reached less consensus:

“The management culture in Brazil is not a main problem. Although there are deficits in terms of managerial quality, this is probably due to the fact that there are relatively more small and familiar firms in Brazil” (industry supplier tier 1)

BLOCK “C”

Interviews indicate that Brazil appears not to be very competitive, thanks to higher production costs and lower quality. The production costs would be a result of “custo-brasil”, oligopolized markets, and the relatively higher wages (in comparison to developing countries, especially in Asia), and these costs would add up throughout the entire value chain. Although labour costs are losing importance as cost-factor, this seems to still play an important role, at least among competing emerging markets, when explaining FDI decisions.

“One input that is really damaging our competitiveness is the cost of steel. Although we know the price is largely given by world markets, the domestic prices are also influenced by the fact that we have an oligopoly of steel producers in Brazil". The import of steel happened when the exchange rate was more valued, but now, imports cannot help." (Small autopart producer)

"Input costs in Brazil were 60% higher than in Argentina, and 30% higher than in Mexico, before Inovar-Auto. The costs in Mexico were lower because Mexico hold labour costs down within the entire value chain" (Government).

Specifically, regarding the access to better and cheaper production inputs and technology, it was widely acknowledged that multinationals (all automakers and most of Tier-1 autopart firms) face no barrier to access foreign technology, apart from the costs to import it. Some interviews also pointed out that there are mechanisms to reduce the tariffs for imported inputs, when these inputs are used to produce goods for exports or when there is no domestic production of similar inputs:

A simple lack of access to imported technology, or lack of absorptive capacity, does not exist in the sector. (Automaker with high volume)

"Access to imported inputs is not a big barrier, as automakers and Tier 1 bring parts and components and only assemble it in Brazil. This happens with most parts with high value-added. The only parts bought from domestic producers are the ones with lower aggregated value. These would always be domestically sourced anyway, thanks to transport costs and also to the low level of technology required. On the other hand, the more technology-intense parts would tend to be imported anyway". (ABEIFA Association)

"Access to imported inputs is not that important as well. Multinational assemblers in Brazil import all auto parts they need with higher technological content. Example: Toyota pickups have on average 60% local content, including labour and profits, meaning that 40% of the value of each pickup is made of imported autoparts. The tariffs paid on these imports can be partially offset by drawback schemes, when assembly is done in one country to export to another, as is the case in the bilateral trade between Brazil and Argentina, for example. The tariff exemption for autoparts

without "similarity" in the domestic market also helps in the case of some autoparts. (Automaker with low scale)

However, the same respondent highlighted that the situation is not so favourable for producers of premium cars, and another automaker pointed out that the existing mechanisms for import tariff reduction or exemption are flawed and costly, thus arguing that the access to imported technology comes with an unnecessary extra cost:

On the other hand, these imports pay average tariffs of around 14%, and the exemption for parts not domestically produced does not work well for premium cars, as these cars use autoparts "similar" to the ones produced domestically, but at a higher quality" (Automaker with low scale)

Low access to technology, given the high costs involved, is an important reason for a lower competitiveness. Brazil does not produce any electronic component. Despite this, the industry needs to pay high tariffs to import these components. The country protects indiscriminately, and this negatively affects the competitiveness of our industry (Automaker with high volume)

"The import tariff is high – the mode for autoparts is 16% - but you have ex-tariffs". (Government)

""ex-tarifario"[93] *does not work properly. It is a poor and weak mechanism*". (*Automaker with high volume*)

Despite the existence of different mechanisms to reduce import tariffs for inputs, firms were divided on the issue of seeing tariffs as a major or as just a minor problem. Among the ones that said this was a minor problem, the majority said that it would be more important to have better domestic suppliers. On the other hand, respondents from the government and academia see the access to foreign inputs as an important source of short-term cost-reduction and long-term competitiveness through the

[93] "ex-tarifario" is a temporary tariff reduction for Capital and Information Technology goods, and also for autoparts, when there is no domestic production of a similar good. Under this scheme, the tariff is reduced either to zero (capital and IT goods) or to 2% (autoparts).

incorporation of better technologies, at least for smaller suppliers, as multinationals have access to all the technology they may need, as already mentioned. This was highlighted for the electronics goods and for specialized services in general. However, the reduction of costs to import higher technology inputs is also viewed as important by firms, thus adding to the argument that frontier technologies are better absorbed in more open economies, and that this facilitates catching up.

"The importance of having access to foreign inputs is there, because Brazil is a relatively closed economy and thus it has either less access to technology or it has less incentives to adopt technology. The costs of inputs are a problem today. Besides this, there is also a problem with availability of some goods… one example: light steel is not produced in Brazil. Embraer relies primarily on access to imported parts… The question of "what to domestically produce within the value chain" is important and does not have easy answers, but there is no way to have local content without sufficient scale. There is, however, room for government stimulus for specific sectors, if this is done properly: encouraging new industries, not specific companies!" (Academic).

"It is not possible to be competitive in everything. In many cases it makes more sense to open for inputs, to gain competitiveness in the final goods". (Government)

"The access to imported intermediate goods, tools and capital goods would definitely benefit the domestic industry in terms of cost-reduction. This would also potentially allow the use of better technologies, as costs goes down. There is not, however, any constraint in terms of knowing a better technology, as the multinationals could access these technologies from their headquarters". (Government)

"In the automotive sector, nobody imports the full system. Instead, firms import parts and pieces, and assemble it in a system domestically. The level of imports is given by the differences in scale for that input – domestically and abroad, adjusted by tariffs and logistic costs. Therefore, for some very innovative or high technology inputs, it may be too costly to avoid imports. Example: for some electronic components there are just two suppliers in the world". (Supplier Tier 1)

“Vehicles are becoming more electronic. This needs to be imported. Even using “ex” the import process makes these inputs at least 10% more expensive” (Industry supplier tier 1).

“More technology-intensive inputs are either produced by tier-1 or tier-2 firms, usually with a project developed abroad, or imported directly by automakers”. (Industry association)

“The domestic electronics segment, for example, is not competitive. This segment sells not only to the automotive sector, but also to other industrial sectors. This segment also uses inputs from other electronic suppliers”. (Industry association)

Another mentioned source of high costs and a barrier for technology adoption was the high tariffs levied on the import of specialized services:

“Tariffs on services are very high” (Industry association)

“One very negative factor for our competitiveness is the high tariffs levied on imported services. We do not face high tariffs for imported inputs, but our imported services are heavily taxed” (Embraer)

Most respondents that argued that the costs of imported inputs and the lack of access to technology in these goods were a less important problem typically came from the industry, including automakers and autoparts. Moreover, answers from automakers and Tier 1 autoparts tended to downplay the importance of accessing technology through imported inputs, probably reflecting the fact that these firms, as multinationals, already have access to most of the technology they need from their headquarters. In this case, the potential advantage of having more access to imported inputs would come by cost reduction. These respondents also are predominantly keen on the need to have a good domestic supply of inputs, arguing that this is very important for competitiveness:

“To avoid exposure to exchange rate fluctuations most firms prefer to buy local inputs” (Industry supplier tier 1).

The nominal import tariffs are high, but if you consider all the tariff exceptions, it does not get so high: it is between 3% and 4%. For example: the problem of tariffs for raw materials is not critical…the biggest problem is that raw materials are not produced with enough capacity to "support" its domestic clients. In addition, having a locally produced raw material or input is an important advantage in terms of logistics (costs and time) and potential strategic partnerships. The most important import barriers are not tariffs. No one survives by importing more than 20%. It has to be located here. A firm business model would rely on importing more than that only if the domestic scale is small, to justify it". (Industry Association).

Regarding machinery, this small autopart producer said that imported machines are cheaper than Brazilian, but because there is subsidized financing for the purchase of domestic machinery, domestic production has a competitive edge. According to him, in 2011 one specific Brazilian machine could be bought for 74 thousand Reais, with an available subsidized loan, while a similar Chinese machine would cost 55 thousand Reais, but without any subsidized loan. He chose to buy the Brazilian one, because he had no resources to pay in cash. The same small autopart producer also gave an example of how regulation can damage an industry: in the 90s a driving regulation established that to drive motorhomes a person needed to have the highest level of driver licence. This drastically reduced the market for motorhomes in Brazil. This legislation was only revoked in 2011. Regarding the new labour law, the interviewee said that it gave more flexibility in terms of working schedule and also softened the power of labour unions, but it did not reduce labour costs. Although not mentioned in the interview, there is a direct link between more work schedule flexibility and less litigation, that can then relate to future reductions in labour-associated costs.

A comparison between the automotive sector and the aeronautical sector is insightful, as the aeronautical sector, represented mainly by Embraer, face different competitiveness conditions.

"Embraer uses high value-added components, at low scale, while vehicle assemblers are the opposite: they use lower value-added components, at high scale". (Automaker with low scale)

A representative of the firm explained that Embraer is much less negatively affected by the high logistic costs of Brazilian infrastructure, as the firm receives its imported inputs usually by air and exports its final goods also by air. Another reason for not being that affected by transport costs is because Embraer operates within a cluster, in Sao Paulo. Finally, as Embraer exports 90% of its production, it takes advantage of a series of tax reliefs aimed at major exporters.

The same respondent said that the firm outsources many inputs that it would be able to produce by itself, but that are cheaper when bought from other companies abroad. Even if not used, this ability is strategic, as the firm is insured against eventual excessive rising prices for these inputs (Embraer would be able to produce them if they become expensive to import).

Although there was always a good supply of domestic specialized labour (aeronautical and mechanical engineers), Embraer is equally affected by labour costs. The interviewee also explained that the company needs to import a vast amount of specialized services, to develop new technologies, but the import of services in Brazil is heavily taxed. So, despite the fact that Embraer is able to import input goods with none or at very low import tariffs, it is heavily taxed – as any other Brazilian industry – when it imports services.

These services are provided by other global clusters and could not be supplied domestically, as they require global scale to be competitive. Thus, the interviewee argued that protection in this case is pointless.

However, although able to easily import any required part or machinery, the firm considers it simpler to negotiate and do business with firms established domestically. It makes financial sense for many suppliers to be located domestically, and many of them are small firms with domestic capital. Asked about the competitiveness of these firms, the representative of Embraer said they are competitive, but that they need to expand their operations abroad to keep abreast of the competition. According to him, these domestic suppliers rely too much on Embraer, and face difficulties related to "custo-brasil" to export more.

The Embraer representative also highlighted that protection from international competition reduces efforts by firms, thus making them less competitive in the future. On the other hand, when a firm is exposed to international competition – as is the case of Embraer – it needs to invest in technology and productivity. The firm invests 10% of its turnover in R&D. The interviewee also commented that the simple focus on the domestic market would not imply a lower effort or competitiveness, as these results would happen only if there is protection against the competition.

He also said that Embraer is the final buyer and its suppliers can use the company to gain technology and market. In this sense the company is an "anchor-firm". There are also clear external scale gains due to agglomeration economies of scale.

He also said that the global value chain where Embraer operates is characterized by quality and innovation, and not so much based on price. Moreover, trade tariffs are not a problem for Embraer, as tariffs are very low.

He said that the aeronautical sector does not pay much trade tariffs worldwide, and that there are few players in this value chain. "*The trade barriers we see in the automotive sector in Brazil would be disastrous in the aeronautical sector, as while Brazil does have part of the production chain, our competitors are in developed countries*" (EMBRAER)

BLOCK "D"

Meanwhile, the lower innovation and quality could be a result of the following competing explanations: (i)) weak regulation; (ii) demand based on low income individuals; and (iii) low trade openness, to import both inputs and final goods. The first explanation was usually put forward by policymakers, while the second was usually brought by automakers.

“Brazilian consumers cannot afford to pay the costs of more equipped models. This is our market” (Automaker)

“Wages are low and there is no credit for vehicle purchase. Demand is necessarily for simpler and cheaper cars” (Automaker)

“Imported vehicles bring innovation and foster innovation by the domestic producers. This happens because consumers will demand better domestic products when they are exposed to better imported cars”. (ABEIFA Association)

Given either the high production costs or the lower product quality, some respondents stated that Brazilian plants can only export to less competitive and closer markets, such as neighbouring Latin America ones:

“For the local production to be competitive we need a better business environment (reduction of custo-brasil. Tariffs are of secondary importance. Currently, our competitiveness allows us to export only to Latin America” (Automaker)

According to some comments, the Brazilian market is important for the multinationals, but is viewed as a "second class" one. Citing decisions made by headquarters, an academic stated that:

“Models developed in Brazil are usually solely for the domestic market. The Brazilian market is important for them but is viewed as a "second class" one”. (Academic)

This view is supported by arguments put in different ways:

“Some models were developed in Brazil but are not exported to Europe because they were not designed as global products. One example is the Fiat Argo. (Automaker)

“Automakers would not abandon Brazil. They can, however, let the country lag in terms of technology and do not upgrade their plants”. (Industry Association).

There were opposite views regarding labour productivity within the Brazilian industry in general and the automotive sector in particular. Industry representatives argue there is no labour productivity problems, while the government and the academia say there is:

“There is a shortage of human resources within autopart producers, as Sesi/Senai are not enough to train all the work force”. (Academic)

“There are productivity problems within the sector. There are not enough qualified workers, including automotive engineers”. (Government).

“The productivity of the workforce in Brazil is not a problem. There are no problems regarding labour supply (engineers and technicians). Neither is the exchange rate the problem”. (Industry association)

“Labour productivity within vehicle production, inside the factory, in Brazil is as high as in foreign plants” (Industry automaker)

During the interviews it was not clear how cultural factors could be separated from an eventual lack of management quality. The cultural factor was related to the existence of a "type of capitalism" in Brazil, where business owners, especially of smaller firms, do not have the necessary professionalism nor the required mindset to engage in M&A, to increase productivity in the face of higher competition, or to seek growth beyond the domestic market. This would be a “cultural characteristic” and would include less interest in international exposure, less ability to face competition, and less ability and interest to merge, buy or sell its business:

“The focus on the domestic market is a cultural characteristic” (Industry association).

Others, however, said that this “cultural trace” is not the only cause for the lack of M&A among smaller and familiar firms, pointing to institutional constraints (especially law and litigation biases by lawyers) as another reason:

Another problem, besides being in a competitive market squeezed between two oligopolies, is that smaller autopart firms – tier 3 and 4 – do not have CADIN[94]*. This means they cannot get financing. To overcome this limitation many of these firms use materials supplied by their clients. Why do they not simply die or merge? Well, there are two main reasons for that: one is that banks are not willing to accept these liabilities; and the other is that most of these firms lack a more professional managerial approach…they are extremely amateur. Some consultancies stated that “forging” is messed up, but a small number of firms would be economically viable. (Government)*

Others emphasise the institutional failures that make very difficult for smaller firms under financial distress to be sold or merge:

“The smaller family-owned autopart firms are without any financial condition to invest, and they are not competitive by all means”. (…) “The small autopart firms have financial problems: they do not have a clean credit history to get new credit. These firms need help before a trade liberalization”. (Industry association)

“The main bottleneck in Brazil is the autopart sector. There are too many small and inefficient firms in the market, unable and incapable of doing better and for less. More supply agreements could help those firms to access much needed finance, for example”. (Industry automaker)

One respondent explicitly contradicted those who claimed there was any cultural aspect involved:

“The lack of mergers and acquisitions and the existence of “zombie companies” is characteristic of the Brazilian system, not a cultural aspect of the Brazilian

[94] CADIN is the acronym for “Cadastro de Inadimplentes”, a database with the name of persons and firms that have non-paid debts with the Government.

businessman: banks must be able to take on the management of debtors, without having to pay the previous liabilities" (industry association).

Although the view that protection may just compensate for "custo-Brasil" is the dominant one, especially among industry representatives, one interviewee raised an interesting question regarding a potential inverse relationship: protection may cause non-cooperative behaviour among the business community and therefore reduces the incentives for fighting for a better business environment:

"Businessmen in Brazil do not face the full strength of foreign competition, either in the domestic market or in the export markets, and thus are not that interested in solving international competitiveness bottlenecks such as the business environment. Instead, they prefer to find ways to get advantages against their domestic competitors, within a bad business environment that can ultimately be an entry barrier in their favour" (Government)

This point of view was also indirectly mentioned by an industry representative:

"Any protection given to the industry should have a clear end. The current protection structure did not generate true benefits. On the contrary, it generated a certain ease and it avoided the needed discussion of the real problems" (Industry representative)

It seems likely that there is an equilibrium, where the government fears rising unemployment and loosing important segments of manufacturing, while the private sector does not move forward a stronger agenda for future competitiveness:

"The arguments for keeping the current level of protection, or even to increase it, are now mostly based on employment considerations or on the fear of premature deindustrialization, caused by both unfair Chinese competition and poor competitiveness conditions among Brazilian firms. The discourse from some industrial associations is that without these (manufacturing) tariffs Brazil could turn into a big farm. It is a myopia that is costing a lot in terms of our future economic prospects" (Government official).

Directly questioned about why there is no successful lobby/pressure to improve the business environment, an automaker answered that "*the business sector in Brazil lost part of its coordination capabilities. Today there is not an organized group of Congressman defending the industrial sector. This is partly due to a short-term vision by most of the businessmen in Brazil*" (Automaker)

Further questioned if this lack of effort to improve the business environment could be the result of a dispute between producers of final goods and producers of inputs, the same interviewee said: "*Maybe, to some extent. But I believe the short-term vision explanation accounts better for it*" (Automaker)

There was a consensus that "custo-Brasil" is among the most important reasons for the relatively low competitiveness of the Brazilian industry in general, and the automotive sector, in particular. Most respondents put issues related to the business environment together with issues related to the lack of scale in production as the main causes oflower competitiveness:

"To gain competitiveness (defined previously as a combination of innovation, quality and productivity), the most important factors to improve are the "Custo-Brazil"; the average scale of production; the participation in GVCs; and the access to foreign markets" (Industry association);

"To promote long term competitiveness, it is essential to tackle the "custo-Brasil". Besides, the low scale is a problem in Brazil…for some goods simply there is no viable scale in the country…this is also caused by limitations in income" (academic).

Some responses – all from the industry - were even more incisive, saying that this was <u>the most</u> important problem:

"Business environment is really bad in Brazil, and the main cause for the lack of competitiveness" (Industry supplier tier 1);

"The biggest problem for investments in Brazil is uncertainty and high taxation (…) "Custo-Brazil" is fundamental" (Industry automaker).

A much stronger criticism of the tax aspect of the business environment identify it as a crucial factor negatively affecting overall competitiveness:

"The taxation system in Brazil is a machine of inequality and inefficiency, for people and for firms. A cumulative PIS/COFINS disincentive value added. Exports are taxed, because part of the domestic taxes is not recovered. Only firms that are big enough can afford to pay good accountants and tax lawyers and then reduce their risk of being fined for some compliance error. And there are sectors who do not pay, because they got "incentives", and firms that do not pay because they just avoid taxes, thus creating an unfair competition. It is a mess, a total mess." (small autopart producer).

According to some responses, a bad business environment not only damages competitiveness of current industries, but also make it more difficult to adapt or develop new technologies. One channel for this negative effect on technology adoption would be protection, which is higher to compensate for a worse business environment:

"Custo-Brasil leads to protection and protection leads to lower technology" (Industry supplier tier 1).

However, the negative effect on adoption and innovation could also happen regardless of protection:

"The business environment in Brazil is not good for the attraction and creation of more modern industries or platforms" (Academic).

"The problem is a combination of custo-brasil, tariff structure and demand instability. Tariff protection for inputs damages technology adoption, while protection in the final goods damages competition, that, is in turn, a disincentive to innovation" (Government).

"The industry worldwide is going through a deep technological transformation. The Brazilian industry is finding it difficult to follow these technological developments,

mainly because of the difficulties imposed by "Custo-Brasil" (high logistical costs, among others). The proof that the problem is out of the gates of the factories is that we have "industry 4.0" engine factories within Brazil, exactly as the ones built in China, but we do not have the same competitiveness "(Automaker)

The most negative aspects of "custo-Brasil" cited by the interviewees are political, economic and legal uncertainties; high interest rates; high levels of litigation and regulatory burden; poor infrastructure and urban violence.

As pointed out by a Tier 1 supplier: *"The problem is not sectoral, it is macroeconomic, it is mainly the high interest rates and the legal uncertainty (lack of rule of law), but it also includes poor infrastructure, a complex tax system and labour legislation".*

The interviewee cited examples to demonstrate that among multinationals operating in Brazil, the litigation related to labour was heavily concentrated in the Brazilian operations: in a specific example it was declared that this specific type of litigation could easily consume around 2% of the firm`s net income. The same interviewee also cited violence (property and personal security) and irrecoverable tax credits as other sources of costs related to the business environment and Brazil`s characteristics in general.

It was repeatedly said that without "custo-Brasil" the Industry would be competitive even without tariffs. Moreover, among some interviewees we noted a disbelief in the political will to improve the business environment, as can be seen from this excerpt: "Manufacturing is not a priority in Brazil" (Automaker with low scale)

It was repeatedly mentioned that the bad business environment is a cause for the level of protection and that "custo-brazil" is a more important factor in reducing competitiveness than tariffs on inputs:

"A reduction in the import tariffs for electronics that are used in autoparts, as, for example, electronics to be used in electronic injection systems, would be beneficial for these autoparts. But this benefit is overshadowed by the "custo-brasil", in terms of cost reduction. However, if we consider the benefits in terms of technology embodied, it

may gain relative importance. The tariffs try to compensate for "custo-brasil". If "custo-brasil" was sufficiently reduced, firms could face zero tariffs and survive". (Industry Association).

A business association devoted to imports within the automotive sector argued that "political and economic instability" are the reasons for making the bad business environment a drag on competitiveness.

"The Brazilian industry is not competitive basically, because of "custo-brasil. The profitability within small manufacturing firms is low, as well as within some bigger firms. As an example, a supplier of Renault said once that the assembler (Renault) makes only around 200 US dollars as net profit per car sold in the medium segment". (Small tier autopart producer)

"Most of the small firms are in a "subsistence mode", and if you are able to grow you start to face even higher increases in costs: you need to deal with more labour and environmental regulations, and also the taxation system gets more expensive. For example, the "Simples" tax regime gets much more expensive when you have a higher turnover" (Small tier autopart producer)

Although Embraer relies on the world market, a better business environment is always important. Moreover, as a very dynamic sector, innovation is always happening. "*We need better conditions to face upcoming competition from new players, and also to keep abreast with innovations such as electric airplanes, for example"* (Embraer).

There was widespread support for a more "horizontal" type of industrial policy, based on clusters and partnerships with the Government to identify bottlenecks and to promote competitiveness, exports and internationalization of firms. It was mentioned that more and better regulation, in terms of standard settings, is needed to promote technology adoption and development, but the low-income levels of domestic demand, and even an alleged lower capacity from Brazilian firms, could be a barrier, unless the investment is focused on exports. Moreover, regulation/industrial policy[95] should not bring uncertainty and should not be too costly:

"Safety and fuel efficiency regulations for popular cars are a problem in terms of costs. In this sense, it would be very difficult for Brazil to be able to produce millions of low-cost cars with high levels of quality and equipment. Despite this, the way forward is to invest in small cars fuelled by ethanol". (Industry automaker)

"Any technical regulatory change brings costs and reduces the productivity of the production line" (Industry automaker)

"The decision to invest in technology takes into consideration the potential demand. Regulation may complement this demand, but there are limitations in terms of infrastructure and consumers` income. Anyway, predictability is essential!" (Industry automaker)

Academics and policymakers tend to be more incisive in saying regulation needs to push the industry harder, but emphasize the limits in terms of domestic income to pay the higher prices of better vehicles:

"Regulation is key. Brazil should focus on vehicles with highest technological content, to export to the headquarters in Europe and USA. At the same time, it should concentrate on technology that could build on some comparative advantages: for example, instead of trying an electrical car, Brazil should focus on hybrids with alcohol. For these actions to take place there is the need of regulation. Brazil should rely on a more demanding regulation to force firms to improve their products. Otherwise the domestic companies would lag behind. Some Chinese firms, for example, have capability to export to top markets". (Academic)

"The limits in terms of regulation would be the costs and the local demand (given the new prices)". (Academic)

[95] Regulation was mainly referred to, in the interviews, as product or production standards, while industrial policy encompass broader themes such as taxation, subsidies and trade-related measures (including tariffs)

"A way to induce innovation even within a protected market is to use regulation[96]". (Government)

Besides demand bottlenecks, there are also constraints related to institutional and firm-level capacities:

"Only relatively big domestic markets can impose tough regulatory requirements". (Government)

"Regulation is important, but regulation alone is not enough. It would not be possible to rely just on regulation, because Brazil is not California. The Brazilian industrial sector is not efficient and not structured enough to be regulated in a proper way". (Academic)

The industry emphasizes the costs and uncertainty brought by regulation in general, but welcome it in the form of "standard-setting", to help to coordinate private-sector efforts, and believe that, if done "properly", regulation can promote competitiveness:

"Standard settings are a good way for Government to solve coordination problems". (…) "Regulation needs to be more incisive and focused more on product and less on process". (…) "Industrial policy should be based on coordination and clusters. The current one is ineffective". (Industry supplier tier 1)

Some respondents expressed the combined view that R&D investments in Brazil should be pushed by tougher product regulation, accompanied by proper incentives:

"We need a system of regulation that imposes a higher level of technology. We need incentives to engage in real R&D, something that currently is not done in Brazil. As potential paths for these incentives to innovation we would cite the development of hybrid cars using the alcohol technology (comparative advantage). Partnerships with

[96] Standard settings.

research institutions and other firms would be important for R&D, but this does not happen often in Brazil". (Academic)

Regarding incentives for R&D, responses pointed to more room for engineering improvements, instead of trying to develop pure innovations, and to the need f or government incentives:

"Brazil could try to improve its engineering, not necessarily innovation. And for this it is necessary to have better government incentives". (Automaker with low scale)

Still regarding R&D incentives, the overall opinion is that there are reasonably good instruments in place, two of them being explicitly mentioned by several respondents: "Lei do bem" and Embrapii. Part of those who praised the current system of R&D incentives also said that sectoral industrial policies for R&D are unnecessary and even counterproductive:

"Lei do bem is complex, but it works. Together with Embrapii and other instruments, there is no need for more R&D incentives; Sectoral industrial policies are "smoke screens", ideological bias, to hide behind the true causes of lagging behind" (Industry supplier tier 1)

"R&D investment is not a problem in Brazil, as the country is one of the most aggressive ones in promoting R&D. Regulation is important, as long it is made from the point of view of the product, not the process. Moreover, it needs to be done realistically. What is not important or efficient are the incentives". (Industry association)

Another strand of criticism, consistently mentioned, was that both "Lei do bem" and Embrapii are not easily accessible by smaller firms, and a smaller proportion of respondents argued that R&D promotion should be enhanced through partnerships with research institutions and more innovation clusters. Moreover, it was pointed that demand uncertainty negatively affects R&D:

"There is too much uncertainty, both in terms of policy and domestic demand; Incentives for R&D are reasonable and in place. To improve it there is the need to

promote more partnerships between the private sector and research institutions. This would be better if linked to clusters" (LLC: as in Embraer)" (Industry supplier tier 1)

Some interviews discussed more details about the R&D environment in Brazil, to suggest that current legislation is not sufficiently flexible and public institutions (especially universities) are not sufficiently market-oriented:

"Corporate-university partnerships are essential, as we see in the USA. In Brazil, the patent problem is not so complicated. The problem is negotiation. Universities only want to participate "50% to 50%", but the legislation does not allow flexibility. There are also problems of regulatory incentives and tax incidence". (Academic)

Inovar-Auto and the technological gap

Overall, the responses indicated that the technological gap is increasing in the last decades, for most respondents, from al groups, but there are recent exceptions in some subsectors and, for example, energy efficiency (arguably improved by Inovar-Auto, according to one government source and two automakers).

Most answers depicted Inovar-auto as a bad policy: generated costs and did not promote innovation. The responses also highlighted that the local content requirements did not alter the existing local content levels of the biggest plants, and that the protection levels brought about by the policy provided conditions for the arrival of smaller plants but did not change any investment plant for bigger plants (these were, arguably, driven by expectations related to domestic demand). Supporters of Inovar-Auto were among automakers and policymakers, and stressed fuel efficiency gains. Another point raised by the interviewees was that Inovar-Auto did stop the rising import trend of vehicles, but this result was achieved in combination with exchange rate movements as well:

"The technological gap is increasing. Inovar Auto made the automakers less prone to innovate. Custo-Brasil and the exchange rate also played a role. Inovar Auto was only responsible for attracting low-scale plants: the bigger scale plants that came would have come anyway. Inovar Auto did not alter R&D in the sector, nor competition among

autoparts. It did, however, increase competition among automakers. (Industry association)

"The local content requirements of Inovar-Auto did not impact the biggest automakers, as they already had a higher local content. It impacted only the "newcomers" that arrived in the country in the 90s, Honda and Toyota, for example. These are smaller producers in the Brazilian market and as such, it is efficient to import more than do the firms with bigger domestic scale". (Government)

"The new small producers, such as BMW, in fact are bringing CKDs to bypass both the Inovar-Auto protection (30%) and the imports protection (35%)". (Industry supplier tier 1)

"Inovar-Auto contributed to improving fuel efficiency. We have good emissions regulations" (Industry automaker)

"Inovar-Auto was a disaster for the autopart sector: it reduced scale per plant and indirectly damaged the industry by damaging the government budget. It simply blocked the flow of imported cars". (Industry association)

"Imports of vehicles (after Inovar-Auto) went down because of the combination of Inovar auto and exchange rate movement" (industry supplier tier 1)

Specifically regarding whether the higher levels of trade protection generated by Inovar-Auto induced or not a reduction of the average scale per plant, answers were contradictory:

"Inovar-Auto decreased average scale, and then productivity, both within automakers and autoparts". (Industry association)

The level of tariffs protecting a domestic market against foreign competition seems to play a minor role in FDI attraction, as tariffs contribute only to part of the profits, and a diverse array of cost factors and strategic considerations can be of greater importance: according to the interviews, profit maximization and strategic decisions are the aspects that explain the investment decisions of multinationals. For most, industrial policies designed by potential hosting countries do not play a decisive role in the attraction of investments:

"Multinationals decide their investments based on a combination of profit maximization and strategic considerations. Financial aspects of industrial policies do not have much impact on their decisions". (Government)

"The headquarters decide who will be the export platform based on relative costs" (Automaker)

"To decide where to invest, the headquarters search for a combination of profit maximization, market-share (especially the Chinese), and strategic considerations". (Academic)

One automaker, for example, explained that they do not take into consideration any financial aspect of industrial policies, when deciding where to invest. He said his firm make use of these subsidies only to improve their cashflow:

"Once the location is decided, sectoral policies are welcomed to support cashflow generation and further justify the investment to the headquarters" (Automaker)

It was also mentioned that vehicle assemblers need to operate near with Tier-1 firms, and thus investment decisions take supply availability and the investment decisions of these firms into account as well. Moreover, the investment decisions of Tier-1 suppliers are becoming more important:

"Tier-1 firms are gaining importance in relation to automakers". (Government)

"What brought automakers to Brazil was not Inovar-Auto. The policy gave only a small favour for some producers to start a very small domestic production (…) the automakers that built bigger plants in Brazil came because of the domestic market, only. Moreover, if we discard from the calculations those very small plants (like BMW and Audi, for example), we will see that there was not any reduction in the average

scale per plant after Inovar-Auto. On top of that, apart from the crisis` years, firms are operating, on average, at 85% of their plant capacity. This means that they are operating close to their optimal scale. There are plants that function at lower optimal scales, depending on the technology that is used in the production process. For example, if you are producing a vehicle using glass fibre, it could have a much-reduced scale of production, as the process is very manual. Some of these plants can be efficient producing only 6 vehicles per day! They are low volume plants, designed for that". (Automaker)

It is important to notice, however, that the same interviewee acknowledged that the lack of scale is among the biggest obstacles for the competitiveness in Brazil.

New technologies

It was mentioned, by part of the industry and part of the academics, that the importance of imported inputs is higher when the technology is evolving faster, and that protection of high-end inputs should be minimal. It was also mentioned, from all types of respondents, that labour costs are losing importance and that traditional industrial policy is becoming meaningless:

When technology is evolving faster it is more important to have access to foreign technology in general, including through foreign inputs, especially for frontier technology and products. In this sense, for the Brazilian case we should not protect too much the electronics components as an input (Government)

"Future competitiveness will not be based on labour costs…traditional industry is important for transition but is not the future…we need to be exposed to competition and technological change. To do this, we need to go abroad, both exporting and investing". (Industrial supplier tier 1)

"Everything is automated, with robots. The new Honda factory is totally automated! The cost-advantages related to labour are losing importance…they are not impacting competitiveness as they used to do. The future is for technology integrators, such as Embraer". (Government)

“Automakers can easily access imported technology...the only exception is for really high-end technologies. In this case there are problems to bring them to the domestic market”. (Industry automaker)

“Access to the best inputs, from domestic or foreign suppliers, is essential for our competitiveness. As technology evolves, this gain even more importance. For example, in a few years we will have electrical airplanes, meaning that a whole new set of inputs will be needed”. (Embraer)

As already mentioned, “Custo-Brasil” is also viewed as a barrier for the adoption of new technologies:

“The industry worldwide is going through a deep technological transformation. The Brazilian industry is finding it difficult to follow these technological developments, mainly because of the difficulties imposed by “Custo-Brasil” (high logistical costs, among others). (Automaker)

It was also mentioned that current competitiveness in some parts of the value chain does not guarantee a future competitiveness, as technologies can change the entire composition of the value chain:

“Brazil is currently competitive in casting (iron and aluminium), but these are “old technologies” and for these there will be excess capacity and the price will go down in the future”. (Industry supplier tier 1)

There was a widespread belief that R&D activities are becoming more concentrated in global centres, and an acknowledgement that Brazil is not – and probably will not be - among these centres:

“GM recently turned off its entire R&D division in Brasil, in favour of China. GM has different production lines for the developing countries and thus decides where to concentrate its R&D activities for these countries. As Brazil and China are among them, it was an obvious decision to choose China, as this country is much more

competitive to be a R&D centre, at least among the developing markets". (Automaker with low scale)

"Protection does not affect innovation by multinationals, as this is done at the global level anyway, mainly at the headquarters. Besides, it is quite often an industrial secret." Automaker with low scale)

"Electrical and hybrid vehicles will never be developed in Brasil". (…) "High level technology will not be developed in Brasil". ABEIFA Association)

As mentioned before, according to some respondents, the way forward for Brazil would be to provide right incentives for innovation, including R&D incentives and also a better business environment. And these incentives should be channelled to the production of small cars fuelled by ethanol/hybrids with ethanol/ electric cells by ethanol, according to the current trends:

"Brazil lacks a really effective policy for innovation". (ABEIFA Association)

"First we need to differentiate R&D from Engineering. R&D is being located in the headquarters, and there is not much scope for trying to make it domestically. On the other hand, engineering is necessary and also viable to be made domestically: this consists in the adaption of materials, tools and processes to the local conditions. For example, the composition of the grease within engines, needs to be altered in function of the wax type used. We need to incentivize engineering! We need to bring more engineering to Brazil. However, it is expensive to have engineering. The vehicle Ecosport, that is sold in the USA as well, was entirely designed in Brazil. To keep and bring more engineering to Brazil we need more government incentives, because the current ones are not enough". (Automaker)

"There is not enough government support for innovation within Brazil (…) Firms will not innovate without the help of the State" (Automaker)

"R&D by automakers is going to be totally done at firms` headquarters. The room is for tier 2 and tier 3 domestic autopart producers, that engage in R&D, sometimes in a

heroic individual effort, but that could make much more with appropriate support from research institutions or by more cooperation with buyers and suppliers". (Academic)

Only two interviewees mentioned the advantages of a national car:

"Brazil should try to produce a genuinely national car, as it would make the profits to stay in the country, and the strategic decisions would be within the country". (Academic)

"A national car would be important for domestic R&D" (Small scale automaker)

5.2 - INTERPRETATION OF RESULTS

According to the partial analysis from the interviews we have the following:

BLOCK "A"
Internal + external economies of scale
Comparative advantages
Location and investment decisions based on scale

Local content requirements (domestic diversification) x Global Value Chains (specialization)

- Scale is fundamental; scale dictates the efficient local content; and specialization can generate scale gains;
- The lack of openness of the economy, combined to the relative low average income limits the potential size of domestic production and make Brazil a location for production of “second class” vehicles.

BLOCK “B”

Foreign and domestic competition

X-efficiency

Markups

Firm heterogeneity and changes in market-share

Competition and Innovation

Resource allocation (inter and intra-sectoral)

- Trade protection is potentially negatively affecting factor allocation, and thus productivity;
- Regarding the effects on firms’ effort to improve productivity (the so-called x-efficiency), interviews pointed to a mixed situation: while the high levels of protection indeed reduces competition from imports, the high domestic production costs (“custo-Brazil”) and a high domestic competition does not allow for high mark-up levels. However, for smaller firms, besides the high levels of domestic competition pressure, there is also pressure from domestic oligopolized suppliers and buyers. The result is a very volatile mark-up for the bigger firms (arguably fluctuating according to the business cycle of the Brazilian economy and the movements of exchange rates that increase or decrease foreign competition), and a more squeezed mark-up for smaller firms (although they also fluctuate through the business cycle);

- Regarding the levels of both foreign and domestic competition, answers seems to point that domestic competition is higher than competition from abroad. Moreover, it seems that there is much more domestic competition among smaller firms, while foreign competition affects firms according to the sector where they operate (producers of low value-added goods seems to be more shielded from foreign competition). Finally, as foreign competition seems to be dependent on the levels of exchange rate and tariffs, and as exchange rates fluctuates, pressure from foreign competition also fluctuates.

BLOCK "C"
Technologial spillovers
Access to imported inputs
Lessons from Embraer

- R&D activities are becoming more concentrated in global centres, and Brazil is not – and probably will not be - among these centres;
- Usually, multinationals – automakers and most tier-1 suppliers – face no problem to access better and cheaper foreign technology apart from a relatively small extra cost;
- Some high technology imported inputs would be always imported, given the required scale to produce them domestically;
- Smaller autopart producers do face restrictions in accessing foreign technology, and, for them, lower tariffs for high technology inputs would be even more important, as it would not only be an advantage in terms of costs, but also in terms of technology adoption;
- Tariffs on the import of specialized services are increasingly becoming a threat to domestic competitiveness;
- The importance of imported inputs is higher when the technology is evolving faster, and protection of high-end inputs should be minimal, to improve catching-up;

- It was disputed if tariffs are high, after all available mechanisms to reduce it. As stated, the mode for autoparts is 16% and the average is 14%, but if there is no domestic production the tariff is either 0% or 2%, thanks to the “ex-tarifario” regime. The caveat is that the regime is bureaucratic and costly to be accessed by smaller firms (interested firms need to ask for the inclusion of the required imported good in the list of “ex-tarifario”). Moreover, the system also does not work properly when a domestic firm produces a “similar” good of inferior quality and thus hinder the tariff reduction. It is therefore important to measure how comprehensive is the regime of “ex-tarifario”, specially the one for autoparts. One interviewee already suggested a final average of 3 to 4%, after all reductions. It was also said that even with “ex” imports could cost at least 10% more, due to the process involved;
- The example of Embraer, as an “anchor firm”, can be viewed as another argument against LCRs, as a competitive final good producer can generate the conditions for the suppliers to come after, while the imposition of not so competitive suppliers can deter the development of a competitive final good producer.

BLOCK “D”
Business environment, institutions, regulations and industrial policies (including Inovar-Auto and R&D policies)
Location and investment decisions based on the business environment
New technologies
Income levels and quality of labour
Current firm-level productivity

- Interviews favoured a more “horizontal” type of industrial policy, based on clusters and partnerships with the Government to identify bottlenecks, and setting standards for final goods, to promote competitiveness, exports and internationalization of firms. The standard-setting type of regulation is viewed as needed to promote technology adoption but bounded by the limited income levels of domestic demand;

- Regarding R&D incentives, the overall opinion is that there are reasonably good instruments in place, two of them being explicitly mentioned: "lei do bem" and Embrapii;
- Overall, the responses pointed that the technological gap is increasing in the last decades, for most respondents, from al groups, but there are recent exceptions in some subsectors and, for example, energy efficiency (arguably improved by Inovar-Auto, according to one government source and two automakers). However, most answers depicted Inovar-auto as a bad policy and pointed that this policy did not contribute to reverse the aforementioned increasing technological gap: it generated costs and did not promote innovation;
- Inovar-Auto did stop the rising import trend of vehicles, but this result was achieved in combination with exchange rate movements as well;
- Firms may not be interested in improving the business environment if it serves as an entry barrier in the domestic market and if protection gives them what they need to survive competition from abroad. An alternative explanation for this lack of effort to improve the business environment is just the lack of organization, generated by a lack of long-term vision;
- Business environment is pointed as the single most important factor affecting competitiveness, and among it the worst aspects are political, economic and legal uncertainties;
- The bad business environment causes not only higher production costs, but is also a disincentive innovation and the adoption of technology;
- There is a degree of skills shortage within firms, but productivity within automakers and tiers 1 and 2 is similar to the levels verified in developed countries;
- Business environment is pointed as the single most important factor affecting competitiveness, and among it the worst aspects are political, economic and legal uncertainties. It was also widely expressed that the bad business

environment causes not only higher production costs, but also disincentive innovation and the adoption of technology. According to some, with a better business environment tariffs could be reduced to zero;

- Contrasting the automotive sector with Embraer, it was said that the aeronautical sector is less affected by the business environment (it does not have to face the same transport infrastructure problems, and it benefits from lower taxation, as an exporter) and it can import inputs in an easier way. As such, the interview with Embraer does indicates that being less affected by the business environment is a competitive advantage, but it does not provide evidence of its prominence relatively to the easier access to foreign inputs, for example. Moreover, the interviewee related that Embraer is heavily exposed to foreign markets, being under intense competition and relying on a worldwide scale of production of its parts and for its final demand. This is thus a confirmation of the previous statements that the most important determinants for industrial competitiveness for Brazilian firms would be the business environment and scale of production (both for its final goods and for its inputs, what is another way to view the importance of accessing better and cheaper imported inputs);
- Regarding R&D incentives, the overall opinion is that there are reasonably good instruments in place, being two of them explicitly mentioned by several respondents: "lei do bem" and Embrapii. Part of those who praised the current system of R&D incentives also said that sectoral industrial policies for R&D are unnecessary and even counterproductive;
- Labour productivity is controversial: some argue there is no productivity problem or skills shortage within firms, while others say there is.

Overall conclusions

These partial results need to be analysed in conjunction, to extract more meaningful insights, and to eventually solve contradictions. This analysis will also make use of the insights brought by the literature review and by the case study presented in the previous chapter 4.

According to the interviews, confirming a vast theoretical and empirical literature, scale is the single most important factor for competitiveness in the automotive sector.

One of the main questions raised by the literature is if scale is promoted by trade protection or trade liberalization. It is straightforward to build a theoretical model showing that trade protection can allow the survival of more firms and sectors within the protected domestic market. This would imply more scale of production for <u>more</u> sectors and firms that would not even exist under free trade. On the other hand, free trade could promote specialization and thus much larger scale of production for <u>some</u> sectors and firms. This, of course, comes at the expense of the dying sectors and firms. The literature, however, adds more complex issues, such as the degree of importance of the existence of domestic suppliers to allow for the emergence of sectors and firms (potential positive impact), and also the costs implied by mandatory purchases of costly domestic inputs (potential negative impact). These considerations are related to the consequences of trade protection in terms of specialization and scale. Interviews showed a consistent line of argument favouring more specialization. it seems that a focus on specific models, technologies, or stages of value chains, could promote dynamic gains in terms of competitiveness and growth.

Moreover, although the domestic market is relatively big, it has two main factors reducing this overall scale: a) poor infrastructure makes more difficult for some industries to reap the benefits of the entire Brazilian market, either in terms of potential suppliers or in terms of potential buyers; b) the Brazilian market is not big enough to counterweight the average scale that is being observed in the global value chains. This is a phenomenon that, although not entirely new, is growing in importance.

Although more and better regulation, in terms of standard settings, is needed to promote technology adoption and development, the low-income levels of domestic demand could be a barrier, unless the investment is mainly focused on foreign markets. The domestic market is then clearly both not big enough or specialized enough for the required scale to be competitive, and not competitive enough to set higher quality and innovation standards.

There is also a spread disbelief that traditional industrial policies could help. Instead, the interviews point to a more coordinated effort to solve problems in the business environment, together with well-calibrated regulation to foster quality and innovation, and a well-calibrated trade liberalization to foster scale and productivity gains and innovation efforts.

The results from the interviews seems to indicate that the level of protection in Brazil is too high. This means that the allocation of productive resources is very inefficient in the country. An example of this is the fact that the country produces almost everything, apart from the most high-end sectors. Lower protection would make it less profitable to invest in some areas, making specialization more compelling. This is clearly observed within the automotive sector. Measures of productivity, including from the literature and from our exercises, also points to an overall relatively stagnant picture.

So, besides the questions regarding “custo-brasil”, the interviews do not suggest at all that protection, at least in the Brazilian case, promote overall scale of production.

In the interviews, it was mentioned that local content requirements should be set at levels that do not deviate too much from the scale of production of that good, in the country, thus confirming what the literature has to say about the risks of setting too high local content requirements. A clear message from the interviews is that Brazil should not produce everything, because it simply does not have the required scale to do it competitively. Thus, a main policy question is to decide what would be produced locally – and what would not.

Interviews also showed that, although the importance of a domestic supply base is diminishing, there is a percentage of supplies that need to be sourced domestically, both because of costs and strategic considerations. Still according to some responses, this domestic base would exist even under free trade.

As discussed in the literature review, some studies suggested that managerial activities in Brazil are usually less professional than in comparable countries, and this would reflect a relatively higher number of family-owned and smaller firms in Brazil. The rationale for the argument that family-owned firms have a weaker performance is that these owners have incentives sometimes dissociated from the firm's growth and modernization. Another strand of the literature reviewed in this thesis argue that in Brazil there are too many small firms because of barriers to entry and barriers to exit: protection against competition and even the bad business environment provides a barrier to entry, while subsidies to operate (tax breaks, access to privileged regulation etc) and institutional obstacles to mergers, acquisitions and closing of businesses provide barriers to exit. Many aspects of these barriers to entry and barriers to exit were confirmed by the interviews.

The interviews are also consistent with the view that production costs are higher than in less developed countries, but the quality and innovation are lower than in more developed countries.

We also found evidence from interviews that the combination of protection (thus, less competition from abroad and thus a domestic equilibrium with higher prices, allowing less efficient firms to survive) and a structure of incentives that make mergers and acquisitions difficult generates a high number of small, family-owned, less productive and less innovative firms in Brazil. Thus, not only trade protection, but also entry and exit barriers in general, could be contributing to deter productivity and innovation.

Protection – not only trade tariffs, but also subsidies - seems to allow for the survival of inefficient firms, but the bad business environment, with institutional problems that make mergers, acquisitions and the closing of firms difficult, also contribute to the situation. The way forward for Brazil would be to improve its business environment and to provide right incentives for innovation, channelled to the production of goods or models where the country has some comparative advantage or higher scale of production.

Sectoral industrial policies and incentives for R&D are then seen as secondary factors: they can be important and help, but without addressing the main problems related to business environment, industrial policies and incentives have very low effectiveness. However, among the types of industrial policies and incentives the most effective strategy is the one that generates public goods, scale, and coordination, setting guidelines and regulations to allow for firms to plan years ahead. Thus, examples of suggested policies would be: promotion of more traditional clusters; more R&D partnerships with research institutions; interactions between the government and the private sector to identify and solve bottlenecks, in a transparent way; discussion and elaboration of consensus legislation and regulation with a long-term view. Moreover, attention is needed for the smaller firms, that are somehow out of the current system of support and incentives. As these firms lack the representative power that bigger firms have, it would be important to set up special channels for these smaller firms to access and to be contacted by the Government.

Because most (but not all) of the responses blaming the business environment came from the Industry, we need to take this with a pint of salt. They have all the incentives to blame the Government or ask for better conditions, instead of focusing on the potentially excessive structure of protection against foreign competition. However, the sheer number of mentions to “custo-Brasil”, and the details provided to exemplify different aspects of it, suggests this is indeed one of the causes for the low competitiveness of the Brazilian automotive sector. And it is important to note that government officials also acknowledged this.

In this sense, there was also suggested that lower levels of trade protection would provide the necessary push to move these agenda on business environment, and, on the other hand, a better business environment can shape dynamic comparative advantages, working together with the structure of protection.

According to the interviews, confirming a vast theoretical and empirical literature, scale is the single most important factor for competitiveness in the automotive sector. The interviews also suggested that the technological gap in the Brazilian auto sector is increasing, and production in Brazil is at lower quality standards.

Automakers have plants distributed around the world with different scales, but R&D is concentrated in developed countries, where these multinationals usually come from. Although in the last decade we saw an intensification in the transferring of production from developed countries towards large developing countries, the overall picture is of excess capacity worldwide. Interviews and data confirmed the most important factors for investment decisions within the automotive sector: existence of potential for scale (mainly from the domestic market and trade agreements); the availability of good suppliers and technical expertise; productivity and production costs; the overall structure of protection; and the overall business environment.

Interviews also suggested that faster technological progress reduces the scope for trade protection, as it increases the risks of lagging behind. This is not to say industrial policy should not use tariffs, but responses indicated that other measures are less risky and potentially more effective. These can be seen collectively as improvements in the business environment.

The contradictory responses about labour productivity and also the survival of inefficient firms can be understood as a result of firm heterogeneity in the sector: labour productivity within some firms are world-class, while within others it is not. On the same token, management quality probably has huge variations among Brazilian firms. The effect of trade protection on the survival of Brazilian firms is theoretically sound, and the existence of institutional problems also affecting this result is also well-known and acceptable within Brazil.

The distribution of production worldwide follows two main patterns: investments seeking to explore a domestic market, and investments seeking to use that market as an export platform. The literature also identifies that labour costs are losing importance as a driver for cost-competitiveness. As developing countries traditionally have lower labour costs as one of its key advantages, the falling in its importance may represent a drag in investment plans directed to developing countries in the future. This could counteract the vastly recorded migration of automotive investments towards the biggest developing countries, even if these are driven by the intention to explore that domestic market. The existence of a domestic supply base is arguably also losing importance, as supply is becoming increasingly global (thanks to global platforms increasing average scale). But the debate regarding the consequences of having a less dense economy is still on top of the policymaking agenda. In this sense, it is recommended to provide a comparison of Brazil and an economy that followed the integration in GVC path, such as Mexico, and the other main automotive producers.

In the interviews, it was mentioned that LCRs should be set at levels that do not deviate too much from the scale of production of that good, in the country, thus confirming what the literature has to say about the risks of setting too high local content requirements. A clear message from the interviews is that Brazil should not produce everything, because it simply has not the required scale to do it competitively. Thus, a main policy question is to decide what would be produced locally – and what would not. This question is related to the previous discussion about the existence of inefficient firms within the Brazilian automotive sector. To provide insights to this, we need to take a close look at the heterogeneity of autopart firms, analysing firm-level data.

According to the literature, specialization (fostered by trade liberalization) allows more participation into GVCs, and this could generate more exports. One potential alleviating factor under the heavy protectionist Brazilian structure is the "ex-tarifario" - temporary tariff reductions for capital and IT goods. But this system is depicted as not efficient, by some interviewees.

The "GVC framework" gives a clue on how to upgrade "segments" within the current value chains, in a more "static" approach, while the "industrial policy framework" usually tries to discover how to upgrade all industrial sectors that may have a dynamic comparative advantage. This is one of the main discussions of the thesis: our hypothesis is that the benefits of engaging in GVCs would rise if you really need to use more imported inputs. And you need to use more imported inputs when scale is important and when technological progress is relatively fast. A usual colorary in the GVC literature is that participation in GVCs can provide a growth opportunity for developing countries, through either the upgrading of their industry; the increase of its scale; or the gains from specialization.

There are major suppliers that operate globally, and these companies are gaining importance in R&D within the sector, sometimes even surpassing automakers. Moreover, countries still compete for investments from the multinationals, using policies that sometimes go against WTO rules. As the main R&D activities are located near the headquarters of the multinationals, there is a reduced scope for technological spillovers within developing countries. The most important externality would be in the form of employment and learning by doing.

Contrasting the automotive sector with Embraer, it was said that the aeronautical sector is less affected by the business environment (it does not have to face the same transport infrastructure problems, and it benefits from lower taxation, as an exporter) and it can import inputs in an easier way. As such, the interview with Embraer does indicate that being less affected by the business environment is a competitive advantage, but it does not provide evidence of its prominence relatively to the easier access to foreign inputs, for example. Moreover, the interviewee related that Embraer is heavily exposed to foreign markets, being under intense competition and relying on a worldwide scale of production of its parts and for its final demand. This is thus a confirmation of the previous statements that the most important determinants for industrial competitiveness for Brazilian firms would be the business environment and scale of production (both for its final goods and for its inputs, what is another way to view the importance of accessing better and cheaper imported inputs);

These results are assuming the maintenance of the current paradigm where we have automakers buying autoparts from suppliers and selling vehicles to consumers. However, this paradigm is likely to change to a market where automakers could become providers of transport services, instead of selling products. Moreover, industry 4.0 technologies have the potential to drastically alter the geography of investment and production worldwide.

As industry 4.0 technologies evolve, investment costs and optimal scale tend to be reduced, thus potentially intensifying the speed of changes in production location. Moreover, the existence of a domestic supply base is also losing importance, as the existence of global vehicle-model platforms allow for the concentration of suppliers at the world level, with increasing scale. In this fast-evolving scenario, technology can be developed or adopted more easily where there is a better business environment.

The interviews suggest that a faster pace of technology can make harder for industries that are not connected to the technological frontier to follow through.

We could see this trend as an evidence that the technology development is increasing the gap between leading and lagged countries: developing countries are competing for “failing” industries, with ever lower value-added, while developed countries are competing for the “frontier” industries, with much higher value-added. However, the suggestion by Rodrik (2015) that the reduction of protection left developing countries exposed and lead them to premature deindustrialization is much more controversial. This is because, as suggested by the author, comparative advantages in manufacturing made the difference for Asian countries. Thus, if you do not have such comparative advantages you will need to catch-up faster. The revolving question is then how to promote a faster catch-up in a world with a faster technology growth? Protecting or integrating with the potential sources of technology?

Technology is viewed as a factor that makes protection even riskier, as the technological frontier is moving faster and any step disconnecting the domestic market from this frontier could led to a much more difficult catch-up in the future. This result is also of particular importance for this thesis.

Combining the result that protection is damaging the competitiveness of Brazilian industry, with the result that technology is making protection even riskier, it is not a surprise that virtually all respondents suggested that Brazil should engage in a trade liberalization process. However, because of the “custo-brazil”, the country should do it in a controlled manner, mainly through regional trade agreements – and together with a reduction of the “custo-brasil”. Without reducing custo-brasil and promoting a corresponding trade liberalization the prospects for the competitiveness of the Brazilian industry is quite negative.

The view that bottleneck-coordination activities and clusters are the best way to go is also compelling. In a developing country, with so many constraints to growth and innovation, it doesn`t come as a surprise that that single-targeted and fixed policies are ineffective. To tackle the vast number of problems it is necessary to start with the ones that are limiting the most, and then evolving to other problems that become clearer during the process. It is not simply a comprehensive package of measures, with priorities, but one that evolves along time according to the solution of the previous problems.

A survey conducted by the National Industry Confederation (CNI, 2018), with its associates, concluded that trade barriers negatively affecting competition, and this is negatively affecting Brazilian competitiveness. “Brazil has the second largest average trade tariff on goods imports, of 12.08% in 2016, only behind India, with 12.91%. The tariffs are much higher than other countries and its negative effects are dominant”. In other words, the Brazilian industrial sector is acknowledging that trade protection in the country is too high and reduces competitiveness!

CNI (2018) point to the fact that, from 2006 to 2016, Brazil lagged behind in terms of labour productivity in comparison with its 10 most important trade partners, and this negatively affects the Brazilian competitiveness both in the domestic and in the foreign markets. CNI (2018) also show that the Brazilian Industry vision of how to become competitive and innovative for the medium term (2018 to 2022) highlights the need to solve recurrent and old problems. These would be basically education and the so-called “custo-brasil”. The Brazilian Industry also recognizes the need to develop the capabilities needed for the new type of industry that is emerging. These assessments are not new. What is now becoming evident is that the Brazilian Industry in general believes that solving “custo-brasil” and increasing labour productivity will not be enough to make them competitive at the world stage: they are starting to concede that more foreign trade is necessary (what potentially means not only more exports, but also more imports (CNI, 2018).

CHAPTER 6 – QUANTITATIVE DATA AND ANALYSIS

In this chapter we turn to quantitative data to gain further insights on the relationships between trade-related barriers and industrial competitiveness within the Brazilian automotive sector. Following the methodology established in chapter "3", we will: (i) build and measure new variables and new data series; (ii) analyse the co-evolution of selected secondary and primary data; (iii) derive economic and econometric relationships.

Interviews pointed to the business environment, the quality of regulation, and the structure of protection as potential drivers to changes in scale, competition, innovation, factor allocation (intra and intersectoral), productivity, and the consequent impact on other productivity components and on the competitiveness. However, to keep the present chapter independent from the qualitative one, allowing for the triangulation, as explained, we need an independent departure point that guides our choice of variables and relationships to be analysed. For this we use theory. As we are mainly interested in the relationship among firms, industries and market structures, we use as theoretical background the Industrial Organization branch of Economics.

Following the framework developed in chapter 2, and in view of the research questions, the main questions this chapter will answer are: how competitive is the Brazilian production? What holds it back: lack of scale? High input costs? High taxes? High production costs overall, and “custo-Brasil”? Low competition in the domestic market and against imports? Poor labour and total factor productivity?

The first subsection builds an entirely new dataset to check how competitive is the car production in Brazil, and which are the potential causes for the differences in competitiveness among a set of countries. In the second subsection, we calculate and explore the evolution of real car prices, a central variable for our analysis, also based on a new data set. In the third subsection we analyse the Brazilian domestic automotive sector in terms of market structure and related industrial organization variables of interest. In the fourth we gather data on the cost structure of automakers and of other industrial sectors, in Brazil, to make comparisons and a sensitivity analysis to show the potential impact of changes in key variables on profits, and thus on cots-competitiveness. In the V subsection we estimate the changes in Total Factor Productivity (TFP) for the Brazilian automotive sector, gaining further insights on the interactions among labour productivity, capital intensity, scale of production and TFP from 1996 to 2017. In the last subsection – VI - we run a series of regressions to disentangle aspects of the relationships among variables of interest. We provide reasons for the chosen models, and a brief explanation of unsuccessful attempts as well.

This chapter 6 is then divided into the following subsections:

I – International Comparison of Toyota Corolla prices, using exchange rate adjustments, and testing scale, specialization, trade barriers, taxation and business environment measures as potential explanatory variables;

II - Evolution of real prices of cars from 1989 to 2019 and potential explanations;

III – Industrial organization background, an analysis of the evolution of domestic competition and market-power, and inferences about the interactions among exchange rate movements, imports, scale, concentration and prices;

IV – Comparison of cost structures and sensitive analysis: a) comparison of the average cost structure for automakers in Brazil in 2017 versus the average cost structure of other manufacturing sectors (agricultural machines, motorcycle, aeronautical) in Brazil in 2017; b) sensitivity analysis – how performance and competitiveness are affected by changes in variables related to: i) trade barriers; ii) business environment; iii) scale of production; iv) specialization and labour productivity. This analysis can clarify the effects of inputs costs and also of "custo-Brasil" on different industrial sectors, thus allowing us to estimate its relative importance;

V – Estimation of changes in Total Factor Productivity for the Brazilian automotive sector from 1996 to 2017.

VI- Times series regressions with markups as the dependent variable, both for automakers and autopart producers.

6.1 – INTERNATIONAL COMPARISON OF TOYOTA COROLLA PRICES.

Introduction

The aim of this exercise is to assess the competitiveness of the Brazilian automotive production. Usually, the literature use exports as a proxy for competitiveness, but this can be misleading, as some countries simply have their production devoted for their domestic market, for strategic reasons. In this section we look at final domestic prices as a proxy for competitiveness, and then contrast the results with some traditional export ratio measures. To be able to compare it properly we chose a car model that is produced in different locations around the world – the Toyota Corolla[97], selecting similar models and making several adjustments, as explained below.

Prices of Toyota Corolla around the world are available in specialized websites. However, the idea that Toyota Corolla is a global platform can be misleading, as, until the 11th generation, Corollas have been sold worldwide under different names and body shapes. Moreover, prices may differ because of different model specifications, market positioning[98], and the inclusion of different taxes, fees, and insurances. To minimize these potential distortions and to overcome the difficulties in comparing different models and names, we engaged in a carefully examination of each chosen model and price, choosing models that are as comparable as possible. The research included an account of how the 11th generation evolved, how it differs around the world, and how is the new 12th generation, that, as explained below, aim to reunify the Corolla as a truly single global platform.

The second adjustment is to separate the eventual short-term effects of the exchange rates movements on the prices measured in an international currency. Any international price comparison is sensitive to the exchange rate of the moment. To alleviate this measurement difficulty, we used the market real exchange rate average from the last 13 years (2006 to 2018). The calculation is explained in the following sections.

The third adjustment is to eliminate from our sample the countries where the Corolla plant has a scale of production substantially below the minimum efficient scale of 200 thousand vehicles per year. Industrial Organization literature points to the existence of a minimum viable scale, instead of an optimal scale (thus, we do not set a superior limit). According to our interviews, the minimum efficient scale would range from 150 to 200 thousand cars per year, depending on the production chain arrangements: a production with less local content, and more access to inputs within Regional Trade Agreements, or with a bigger external economy of scale, resulting from a bigger total

[97] Another option would have been to use the Volkswagen Golf.
[98] Pricing and marketing strategies also contribute to different prices around the World. As pointed by some of interviewees in chapter 5, price reductions for specific models, time, and market are a way to respond to competition and consumer demands.

domestic production, for example, can reach the minimum efficient plant scale at a lower level.

The fourth adjustment is to deduct sales taxes, aiming to reach a proxy for the ex-factory prices, and thus deducting the effects of taxes that would be exempt in case of exporting. This adjustment will be made only for he models from plants with production scale above the minimum efficient threshold.

We do not adjust for differences in dealer`s margins and neither for differences in country-specific equipment packages, as we do not have precise data on it for the entire sample and we assume they tend to cancel each other: higher dealer`s margins are usually seen in developing countries[99], while models sold in developed countries usually come with a better equipment package.

After the necessary adjustments we can compare consumer selling prices in all countries that manufacture a Toyota Corolla (or the same car under another name)[100]. We restricted our comparison list to producing countries because we want to check relative production competitiveness in production.

Background information: Toyota`s production strategies and main data

Toyota is the biggest automotive producer in the World, in sales[101]. It is widely acknowledged that the company gained market-share worldwide applying successful managerial techniques, including a lean manufacturing idea and efficient quality controls, translated into the "Toyota Production System (TPS)"[102]. Moreover, because the company is the biggest in the world, scale gains are secured throughout its global value chains. Toyota is consistently among the best performers in terms of operating

[99] Based on two interviews (one automaker and one tax specialist with experience in the automotive sector) that stated that Corolla is considered a small car for developed markets, where the dealerships` markup would be between 5%-15%, while in developing markets, where Corolla is considered a medium sized car, and margins need to be higher to compensate for a worse business environment, the dealer` markup would be around 10-20%.
[100] We did not include Venezuela, as its production was almost zero in 2018, due to the economic crisis faced by the country, and hyperinflation would make impossible to compare prices.
[101] Source: OICA, available at http://www.oica.net/category/production-statistics/2016-statistics/
[102] https://www.toyotauk.com/the-toyota-charitable-trust/lean-approach/

and profit margins[103]. For the fiscal year ending in March 31st, 2018, Toyota had the following main results, with worldwide production and sales, but concentrated in Asia and North America (table 1). In fact, almost 50% of Toyota`s production (and 25% of sales) comes from Japan, its headquarters and main export base in absolute terms:

Vehicle production and sales: 8,964,000 vehicles

Net revenues: 29,380,000,000 ¥

Operating income: 2,400,000,000 ¥

Operating margin (in % of net revenues): 8.2%

Table 1 – Toyota`s worldwide production and sales, per region

Production location	**Sales location**
Japan: 47.8%	Japan: 25.2%
North America: 21.2%	North America: 31.3%
Asia: 17.9%	Asia: 17.2%
Europe: 7.5%	Europe: 10.8%
Other regions: 5.5%	Other regions: 15.5%

Source: https://www.toyota-global.com/investors/financial_data/high-light.html

In its strategy of increasing scale and reducing costs through shared platforms Toyota faces the need to make all Toyotas produced worldwide more similar to each other. This is a shift from the previous strategy of trying to adapt products to local markets, keeping a few different platforms. The result of the previous strategy is that, for the

[103] According to company reports gathered by the specialized finance press, global profit margins for the main automakers vary substantially, ranging from near zero to almost 7% annual, on average, in the last decade. An average of around 4% annual is somehow representative. By the same token, the average operating margins would be around 5% annual, lower than the average for Toyota.

Corolla case, for example, there are different models in different markets[104]. The upcoming 12th generation of Corolla will be based in the Toyota`s New Global Architecture (TNGA) set of global platforms. As explained in the specialized press, “The outgoing 11th-generation is actually three different cars on three different platforms. That finally changes with the introduction of the Corolla hatchback that hits U.S. showrooms this summer. It is the lead model for a new family of Corollas, including an upcoming sedan and wagon, that will all be based off the same completely re-engineered global platform”[105]. The text further confirms that “Migrating all versions of the Corolla to the Toyota New Global Architecture platform is an important evolution for the compact. It will help build brand value and marketing power and simplify product engineering as well as help achieve better economies of scale. But it also is testing Toyota's manufacturing acumen by requiring the company to quickly convert all 16 of its Corolla plants worldwide to the TNGA production setup”[106].

Moreover, the names adopted varied, as well the body type (sedan/saloon; hatchback; narrow body). The sedan/saloon is based on the platform E170 (2,700mm wheelbase); while the hatchback uses the E180 platform (2,600 mm wheelbase) and a narrower sedan[107] that uses the E160 platform (2,600 mm wheelbase). The names are quite diverse, including “Auris”, “Corolla”, “Altis”, “Levin” etc. The new TNGA platform will unify the currently different ones, and the new models will also share the “Corolla” name, globally[108][109][110]. According to the Toyota website, the Toyota New Global Architecture will comprise four segments. In the C-segment, the new Corolla (TNGA E210) will have 2,700 mm and 2,639 mmm for sedan and hatchback, respectively[111][112].

[104] According to the information gathered in specialized magazines, Corolla used to share the same platform worldwide before 2011, but the 11th generation (presented in 2012) of Corolla changed this pattern.
[105] https://autoweek.com/article/car-news/2019-toyota-corolla-goes-global#ixzz5Yo6PmE7X
[106] https://autoweek.com/article/car-news/2019-toyota-corolla-goes-global#ixzz5Yo6waY8F
[107] Intended for the Japanese, Hong Kong, Sri Lanka and Macau markets, due to size governmental regulations and incentives.
[108] https://en.wikipedia.org/wiki/Toyota_Corolla_(E210)
[109] https://www.toyota-global.com/company/profile/facilities/
[110] https://www.toyota-global.com/company/vision_philosophy/toyota_production_system/
[111] https://www.toyota-global.com/company/profile/facilities/
[112] https://www.toyota-global.com/company/vision_philosophy/toyota_production_system/

Toyota has assembly plants for Corolla in the following countries: Brazil; Canada; China; United Kingdom; Venezuela; India; Japan; Pakistan; South Africa; Taiwan; Thailand; Turkey; and the United States. However, production of the new hatchback, started in June 2018, and of the new sedan and wagon, expected for 2019, will be held initially at the following plants[113][114][115]:

- Japan: Toyota, Aichi (Takaoka plant)
- China: Guangzhou (GAC Toyota); Tianjin (FAW Toyota)
- United Kingdom: Burnaston
- Turkey: Sakarya
- United States: Blue Springs, Mississippi (TMMMS); Huntsville, Alabama

Models and prices per country

In the appendix we provide details about each model we chose as a valid comparator, for each country. As a general rule, we chose sedan E-170 models, but for the markets where these are not produced, we chose the most similar, as the hatchback E-180 (usually around 10% more expensive, in markets were both options are available). The engine sizes and trims were also chosen to be the most similar possible. In this sense we chose the cheapest model with automatic gearbox, petrol, and engine size between 1.6 and 1.8 litres.

As we are interested in comparing cost-competitiveness across countries, we ideally would use export prices for Corollas. These export prices would be exempt of indirect taxes not charged in exports. However, as this data is not available, we need to use a proxy based on retail prices. For this to be useful we need to identify the sales taxes charged in each country and verify if the retail price is inclusive or not of these taxes. We recognize the limitation of this exercise and thus results should be taken with a pinch of salt.

As an example, the table 2 below analyses in detail the tax structure for car manufacturing in Brazil:

[113] https://www.toyota-global.com/investors/financial_data/high-light.html
[114] https://www.toyota-global.com/company/vision_philosophy/toyota_production_system/
[115] https://www.toyota-global.com/company/profile/facilities/

Table 2 – An example of the taxation incurred by a car in Brazil

Retail price: R$ 77,000.00
Dealer`s margin: R$ 7,000.00
Invoice price to the dealer: R$ 70,000.00
Cost to manufacture: R$ 40,000.00
IPI (13% on the total cost to manufacture): R$ 5,200.00
ICMS (18% on the total cost to manufacture): R$ 7,200.00
PIS and COFINS (1.65% + 7.6% on the gross revenue): R$ 6,475.00
Sum of IPI, ICMS, PIS and COFINS, paid by the automaker: R$ 18,875.00
Gross profit by the automaker: R$ 70,000.00 – R$ 40,000.00 – R$ 18,875.00 = R$ 11,125.00
Income tax (25% on gross profits): R$ 2,781.00
Net profits: R$ 8,344.00
Export price: R$ 30,000.00 + international freight

Source: Author`s calculation

Thus, Toyota Brazil could export a car that it sells domestically for R$ 70,000.00, for as low as R$ 30,000.00 plus freight. Each country has a different tax structure. For a country with very high tax rates the retail price will hide a greater part of its competitiveness. Different profit margins in the domestic market – both for the automakers and for the dealers - can also make an important difference.

Further details about sales taxes; and delivery, processing and handling fees is explained in the notes for each case. No optional accessory is included.

Adjustments

We converted the prices in domestic currencies in 01/12/2018, using market exchange rates. However, this market exchange rate may be biased, because of some conjunctural factor affecting the exchange rate at that time. Therefore, we setup a procedure to minimize potential conjunctural discrepancies in the market exchange rates, using the average real (constant) exchange rate from 2006 to 2018.

This adjustment provides a clear account for our main concern: the possibility that the market exchange rate used in the moment of the price comparison be under or overvalued in relation to its long-term average because of conjunctural/short-term factors (such as, for example, an economic crisis or a sudden influx of capital).

We transform the annual average nominal exchange rates of national currencies per U.S. dollar into constant values using the consumer price index, both provided by the International Financial Statistics/IMF. For 2018, most data are updated up to November, and we work out the 2018 average as usual. When data is less updated (to the first, second or third quarter of 2018) we calculate a linear extrapolation of the previous changing rate. As there is no consumer price index data at the IMF for Taiwan[116] we use instead the National Statistics Bureau of Taiwan as data source.

The average exchange rate is calculated summing the annual period average of the exchange rate at constant values, from 2006 to 11/2018[117], and them dividing the result by 13, the number of years:

[116] "Taiwan, China, is not listed as a separate country for World Development Indicators. For most indicators, Taiwan, China, data is not added to the data for China, but Taiwan, China, is added to the world aggregate and the high-income countries aggregate. There are some exceptions". Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/114933-where-are-your-data-on-taiwan

[117] Source: International Financial Statistics (IFS)
http://data.imf.org/?sk=388DFA60-1D26-4ADE-B505-A05A558D9A42
http://data.imf.org/regular.aspx?key=61545862
http://data.imf.org/regular.aspx?key=61545861
Source: National Statistics Bureau - Taiwan
https://eng.stat.gov.tw/point.asp?index=2

Table 3 – Corolla prices

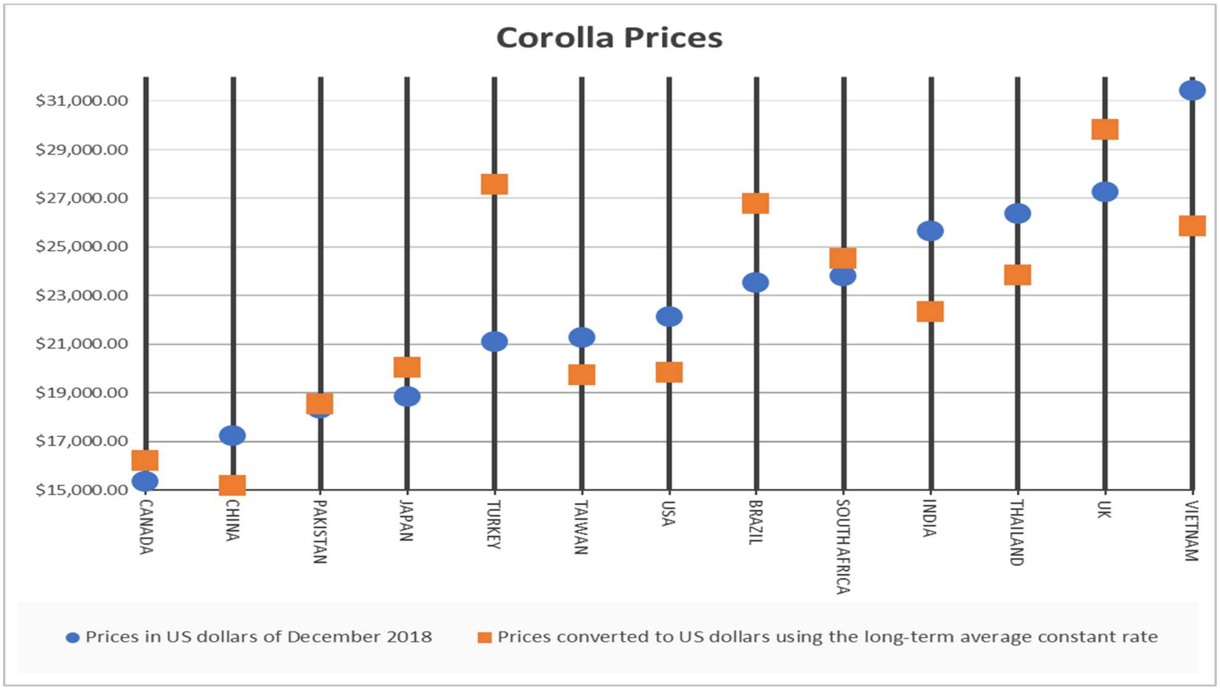
Country	Corolla price, in domestic currency, on 01/12/2018, with sales taxes included (A)	Nominal exchange rate to the US dollar, on 01/12/2018 (B)	Corolla price converted to nominal US dollars on 01/12/2018 (C = A/B)	Average of real (constant) market exchange rates (2006-2018) (D)	Corolla price converted by the average constant exchange rate (E = A/D)
Canada	$25.031,00	1,3280	$18.848,64	1,2584	$19.891,06
China	¥119.800,00	6,9540	$17.227,49	7,8973	$15.169,72
Pakistan	Rs 2.674.000,00	140,1990	$19.072,89	138,7848	$19.267,24
Japan	¥2.138.000,00	113,5640	$18.826,39	106,6194	$20.052,64
Turkey	₺110.000,00	5,2140	$21.097,05	3,9889	$27.576,52
Taiwan	NT$656.000	30,8670	$21.252,47	33,2268	$19.743,10
USA	$22.135,00	1,0000	$22.135,00	1,1168	$19.819,41
Brazil	R$ 90.990,00	3,8670	$23.529,87	3,3992	$26.767,71
South Africa	R330.000,00	13,8680	$23.795,79	13,4601	$24.516,96
India	₹ 1.788.000,00	69,7100	$25.649,12	80,1229	$22.315,73
Thailand	฿869.000	32,9740	$26.354,10	36,4480	$23.842,18
UK	£21.520,00	0,7900	$27.240,51	0,7217	$29.818,10
Vietnam	733.000.000 ₫	23.317,6320	$31.435,44	28.341,0787	$25.863,52

Sources: (1) Corolla prices from dealers price lists at national Toyota websites; (2) exchange rate raw data and consumer price indexes for all countries from the IMF, except the Consumer Price Index for Taiwa
sourced from the Taiwanese Directorate-General of Budget, Accounting and Statistics.
Adjustments and calculations by the author, as explained in the text. Prices includes freitgh, when this information is available

The adjustments by the average exchange rate provide a more accurate perspective of the price differences among our sample. The chart below presents the prices (before the sales tax deduction) using each of the two exchange rates used. There we see, for example, that the December 2018 exchange rate against the U.S. dollar (the blue circle dot) for Turkey, Brazil and the UK are undervalued relative to its 13-years average (the orange square dot). The Turkish case is the most pronounced in our sample. Thus, if we adopt the nominal current exchange rate, a Corolla in Turkey would seem much cheaper (around 21,000 dollars) than if we adopt the average exchange rate for the same price conversion (around 27,000 dollars). These exchange rate differences are in line with the fact that Brazil and Turkey experienced recent economic downturns and political uncertainty. This last reason also applies to the UK, after the Brexit vote.

It is important to notice that the E-180 platform is usually 10% more expensive than the E-170. In the sample, the E-180 platform is used by Japan and by the UK. In this sense, if we deduct this 10% from the UK price, we would have the British and the Turkish model as approximately equally expensive.

Graph 1 – Corolla prices, converted into U.S. dollars using nominal December/2018 and 13-years average constant exchange rates



On the other hand, China, the USA, India, Thailand, and mainly Vietnam seem to have an overvalued exchange rate, vis a vis its own long-term average.

However, although it is necessary to adjust for potential conjunctural misalignments of the exchange rates, the use of an averaged measure has also its potential drawbacks:

(i) One potential problem is that it is possible for the long-term average exchange rate to be either undervalued or overvalued, against other metrics or timespans. In our sample, this may be the case of Vietnam, as explained further in this section;

(ii) Another potential source of measurement problem is that exchange rate variations can be buffered by profit margins. If this is the case, a calculation using the average exchange rate would not take into account eventual reductions or increases in the profit margins as a response to that exchange rate movement (as this averaged exchange rate is calculated but was not observed in the real world). Thus, it is plausible to assume that the price change, in dollars, resulting from an exchange rate equal to the average exchange rate, would be smaller than our calculation. For example: as already showed, the Brazilian Corolla price tag was around 23.5 thousand dollars in December 2018, using the exchange rate of that time. An eventual regression towards the 13-years-mean would imply a price around 27 thousand dollars, also accordingly our calculations. However, as this long-term average exchange rate implies a more valued Brazilian currency, and thus a costlier Brazilian Corolla, Toyota would probably try to counteract this exchange rate movement. The company could do this by reducing its profit margins to do not pass through the entire price increase resulting from the exchange rate movement;

(iii) In a similar way, although a currency appreciation against the dollar can increase the tag price of the domestic final good, it can also make imported inputs cheaper. The net effect on costs, and then on prices, is potentially smaller than the exchange rate movement.

Another potential measure would be to use Purchasing Power Parity (PPP) exchange rates. This adjustment would allow us to convert domestic prices into a common currency (chosen to be the US dollar) using the implied exchange rate that would make average prices in each pair of countries the same. The rationale behind the purchasing power parity is that, in equilibria, prices for any tradable good would be the same, when converted by the PPP exchange rate. This is a generalization of the Law of one price: one dollar in Geneva should by the same apple as one dollar in New York, otherwise someone would move or import the good from the cheapest country[118]. Obviously, this hypothesis is only valid in a world free of transaction costs (transportation costs, tariffs, taxes) and in absence of effects from non-tradables (cost of services involved in the selling of the apple, for example).

Despite the unrealistic assumption of the existence of a comparable basket of goods (same goods, with the same quality) and the absence of transaction costs and

[118] Until there would be no arbitrage opportunity left.

restrictions (tariffs, transport costs, barriers to competition…), average PPP exchange rates could provide a good approximation of the true purchasing power of different currencies, when converted to other currencies. It would be then a way to make values expressed in different currencies more “comparable”, reflecting an equilibria long-term exchange rate implied by the law of one price. However, it is expected that exchange rates converge to PPP values only in the long-term and provided relative income levels also converge. Therefore, PPP values could only be a rough approximation of what would be the “long-run” exchange rate. Moreover, the fact that PPP values are usually calculated using a vast number of non-tradable goods and services make these measurements not entirely suitable as an exchange rate determinant. Because of this, PPP values are usually used to measure the size of economies, providing a better account of differences in countries` GDPs, instead of being an equilibria exchange rate predictor. Thus, PPP values of vehicles would be more suitable to measure the purchasing power of the citizens in that market.

Regarding the minimum efficient scale, we initially applied our minimum range of 150 to 200 thousand vehicles per year, for a given plant, and then look at the scale at model level – the production of Corollas in that plant[119].

The scale data for the entire sample was:

[119] We could also take into account a proxy for the external economies of scale (total domestic production, for all cars) and also the extent of Regional Trade Agreements for each country, but this would bring an excessive discretionary level to the analysis, in an unnecessary way for our purposes.

Table 4 – Scale at model and plant level

Country	Scale at model level: total production of Corollas, Auris and Levin, in 2018	Scale at plant level[1] (Corolla plant) units
Canada	188.710	572.000
China FAW	371.525	536.000
China GAC	200.118	599.000
Pakistan	53.998	61.000
Japan	156.984	397.000
Turkey	59.102	280.000
Taiwan	48.948	118.000
USA	136.240	164.000
Brazil	79.432	198.000
South Africa	18.797	129.000
India	3.345	154.000
Thailand	38.826	524.000
UK	131.850	145.000
Vietnam[2]	2.500	41.000

[1] China has two plants producing Corollas: FAW and GAC (this produces it under the name Levin). The total production is around 1,1 million vehicles per year. We then considered it separately. Japan has two plants producing Corollas, but the version comparable with the other countries is the Corolla Sport. Therefore we use only this plant in our exercise.
[2]Estimated on the basis of news from various websites.
[3]For Japan and the UK, the production includes the Corolla hatchback sometimes called Auris.
Sources: Automotive Industry Portal - Marklines; Toyota worldwide website; Toyota automakers in each country.

Countries below the minimum efficient scale at plant level: Pakistan; Taiwan; South Africa and Vietnam. Among these, Vietnam also shows a very small production of Corollas. Among the countries that show a plant level scale above the minimum efficient point, India presents a very small production of Corollas. Therefore, taking into consideration the scale at model and at plant level, we will withdraw the following countries from our sample: Vietnam, Pakistan, Taiwan, and India. We will keep South Africa in the sample, despite its low scale, because it is an example of a Corolla producer that is similar to Brazil in terms of geographical distance to the main global value chains and consumer markets.

We then estimated the sales taxes applied to each country in our subsample, for the specific model into consideration (table 5). It is important to note that the World Trade Organization does not allow the exemption of direct taxes[120] linked to export targets

[120] Annex I (Illustrative List of Export Subsidies), in the Agreement on Subsidies and Countervailing Measures: "(e) The full or partial exemption remission, or deferral specifically related to exports, of direct taxes(58) or

or to domestic content in exports. However, indirect taxes can be exempted from exports, a practice followed by all countries listed in this exercise.

Table 5 – Sale taxes applied to the sample

Taxes imposed on sales to final consumers, at the domestic market

Country	Taxes and rates	Total implied sales taxes
Canada	GST (5%) included in the HST (13%)*	13%
China	VAT (17%), Purchasing tax (10%), and CT (5%)	35%
Japan	Acquisition tax (3%) and JCT (8%)	11%
Turkey	VAT (18%) and SCT (45%)	71%
USA	Total VAT (local and state): 8.87%	9%
Brazil	ICMS (12%)+IPI(13%)+PIS/COFINS (9.25%)	33%
South Africa	VAT (14%)	14%
Thailand	VAT (7%) + excise tax (10%)	18%
UK	VAT (20%)	20%

Sources:

Price Waterhouse Coopers - Global Automotive Tax Guide. November 2018. Available at: https://www.pwc.de/de/automobilindustrie/2018-pwc-global-automotive-tax-guide.pdf

ACEA tax guide 2018. Available at: https://www.acea.be/uploads/news_documents/ACEA_Tax_Guide_2018.pdf

KPMG tax rates online:https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online.html

EY Worldwide VAT, GST and sales tax guide – 2018:

https://www.ey.com/Publication/vwLUAssets/EY_Worldwide_VAT,_GST_and_Sales_Tax_Guide_2018/%24File/Worldwide%20VAT,%20GST%20and%20Sales%20Tax%20Guide%202018.pdf

Research on dealer`s websites, specialized press, and governamental bodies.

Notes:

Taxes on vehicle ownership are only considered in the table - and thus deducted from the calculated retail prices - if this is attached to the retail price and paid at the purchase moment. The calculations on the percentage size of sales taxes on the final sale price are approximated and for the most general rates applied. It does not include rebates, exemptions and any special law requirement regarding goods and firm specificities, as well eventual interactions with other taxes.

Some rates varies accordingly to the region, state or city. As an example, we assumed the rate for Ontario, Canada; New York, for the USA; and Sao Paulo for Brazil.

When it was not clear how the different taxes were aplied - if cumulatively or not - we just added the diferent taxes as they were not cumulative.

*HST includes GST (apart from Quebec, where there is the GST (5%) plus the QST (9,97%).

social welfare charges paid or payable by industrial or commercial enterprises.(59)" Source: https://www.wto.org/english/docs_e/legal_e/24-scm_03_e.htm#fnt-58

Results

The table below presents the main results. Brazil, for example, has a price tag of 90 thousand Brazilian Reais for a Corolla (as depicted in the previous sections). This, converted by the market exchange rate at 01/12/2018, would be the equivalent to 23.5 thousand US dollars. On the other hand, the domestic price converted by the average of the constant market exchange rates in the last 13 years would be approximately 27 thousand dollars. The table also brings an estimative of sales tax applied for production from countries that reached the minimum efficient scale threshold, as discussed before. After examining which ones were already in the tag price or not, we discounted this from the retail prices, as we are interested in a proxy for the cost to produce the car in that country. It is a very heroic exercise and by no means we intend to provide a measure of real sales taxation.

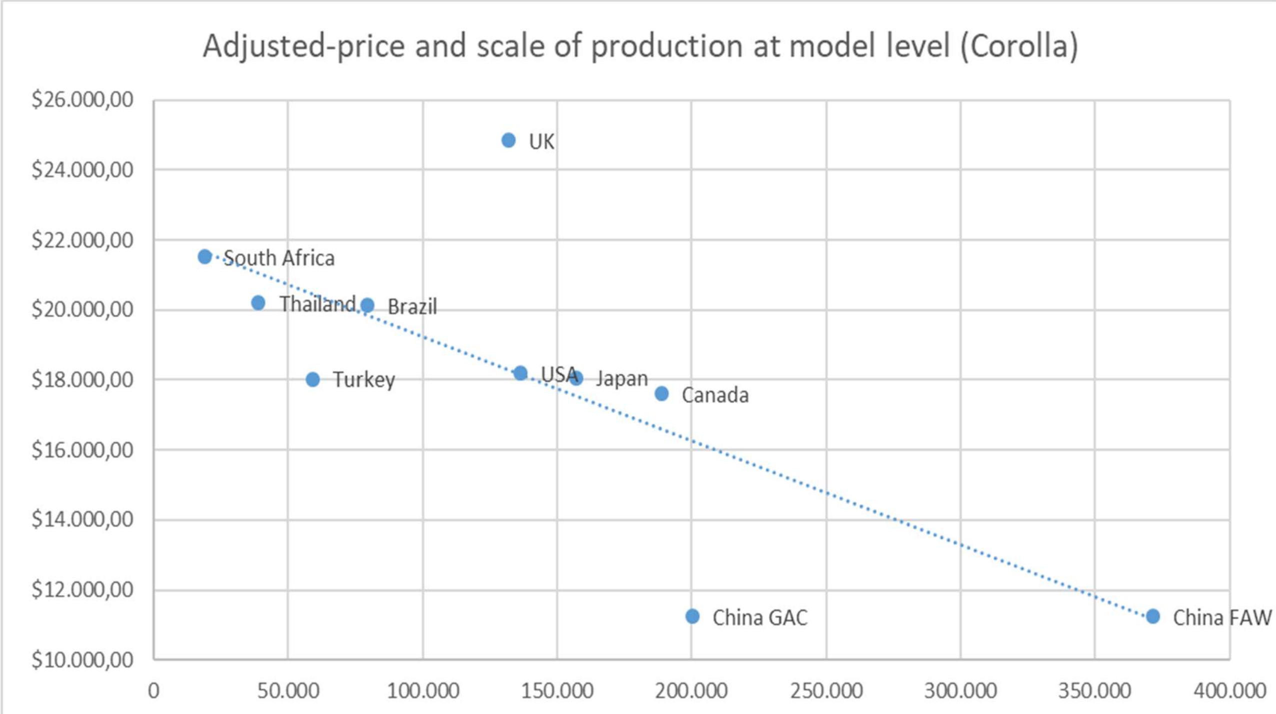
It is important to note that differences due to freight, trims and dealer`s margins are not taken into account.

Scale measures were calculated using two different levels: model (Corollas); and plant (Toyota plant were the Corolla is manufactured).

Table 6 – Corolla prices and scale

Country	Corolla price converted by the average constant exchange rate	Corolla price converted by the average constant exchange rate, net of sales taxes	Scale at model level: total production of Corollas in 2018	Scale at plant level (Corolla plant) units
Canada	$19.891,06	$17.602,71	188.710	572.000
China FAW	$15.169,72	$11.236,83	371.525	536.000
China GAC	$15.169,72	$11.236,83	200.118	599.000
Japan	$20.052,64	$18.065,44	156.984	397.000
Turkey	$27.576,52	$18.023,87	59.102	280.000
USA	$19.819,41	$18.182,95	136.240	164.000
Brazil	$26.767,71	$20.126,10	79.432	198.000
South Africa	$24.516,96	$21.506,10	18.797	129.000
Thailand	$23.842,18	$20.205,24	38.826	524.000
UK	$29.818,10	$24.848,42	131.850	145.000

Graph 2 – Adjusted-price and scale at model level



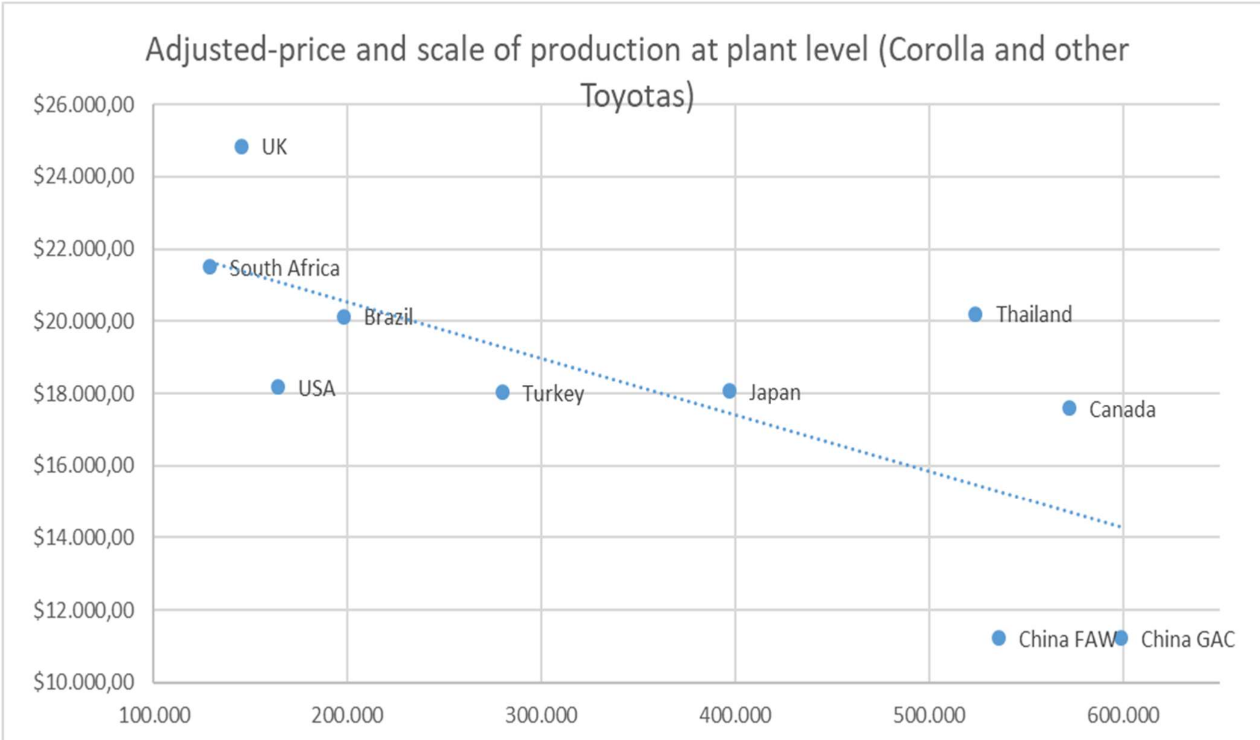
The results show a very strong negative relationship between prices and scale at model level (graph 2). In this case, Brazil seems to be close to the trend line, indicating the prices in the country are relatively as expected given its scale[121]. As we explained before, the UK produces a platform that is on average 10% more expensive than the one produced by the other countries in the table (with the exception of Japan). However, even considering this, its costs are far higher than what would be justifiable by its scale.

At plant level (in other words, total scale of production of the factory where Corolla is produced, including other models) the picture (graph 3) is different:

[121] Scale of production is pointed by our reviewed literature as the main explanatory variable for the production costs. There are, however, different measures of scale applicable to the automotive sector:

- at the vehicle/production line level;
- at the factory level;
- at the firm level;
- at the country level (as a proxy for external economies of scale); and
- at the regional level (if countries are sufficiently integrated, both by physical infrastructure and by trade agreements).

Graph 3 – Adjusted-price and scale at plant level



At plant level there is still a trendline that relates more scale with less prices – and therefore less costs, according to our assumptions. However, in this case, the USA shows more competitiveness than expected by the trendline, while Thailand and Canada show a relatively more expensive price and cost. Brazil remans at the trendline.

One important note is that there can be several taxes applied throughout the domestic production value chain that are not fully deducted when the vehicle is exported. This is a recurrent complaining among Brazilian automakers, but we did not assess these eventual differentials in our exercise, and it is expected that other countries face similar problems with their own tax credit and refund systems.

Scale also can influence costs through the scale of the autopart producing domestically. In this sense, we tend to see a more developed autopart industries in countries with a higher measure of country-level scale (proxy for external economies of scale) and/or, alternatively, in countries with regional trade agreements with important partners[122]. Within our sample, we would expect efficiency gains from regional sourcing mainly for the Asian producers: China, Japan and Thailand. On the other hand, Brazil and South Africa are relatively isolated from global supply chains and the main consumer markets.

To better understanding the dynamics that brought Brazilian costs and prices to the pictured levels we analyse the car price evolution in Brazil, and the domestic market structure, on sections II and III respectively. As we will see, car prices in Brazil were much higher in the 1970s and 1980s.

Conclusions from this section

We infer that Toyota`s decision to change strategy (making models more similar worldwide)[123] could be a result of two different reasons: a) scale is becoming even more important; b) demand and tastes are becoming more similar across the world.

Retail prices for Toyota Corolla, in November 2018, among all countries that produces the car, converted by the exchange rate valid on 1st December 2018, Brazil would be around the middle of the sample, with a price tag equivalent to 23.529 US dollars. If

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122 In fact, a myriad of factors can affect the optimal scale of production. As examples of these factors we cite:

- the degree of participation in global or regional value chains;
- the level of local content;
- the number of production phases undertaken;
- the degree of technological spillovers, availability of specialized labour, and availability and cost of inputs. These factors are part of the Marshalian economies of scale: suppliers; knowledge spillovers; and labour pooling. Since these factors were described by Marshall the underlying mechanisms for them to operate has changed. For example, it is acknowledged by the economic literature that technological progress in communications and transportation allows technological spillovers to be received further away from its geographical source;
- the technology and materials used;
- the degree of standardization of the platform/design;
- the market size or niche;
- the market structure and degree of market concentration/dominance. Examples are Drucker and Faser (2012); Drucker (2011). The conclusion of both studies is that market concentration negatively affects the plant-level productivity for the smaller competitors and industry-level employment, respectively. Moreover, as pointed by Drucker (2011), following a literature review, large firms usually present a higher degree of vertical integration, thus making more difficult for the emergence of independent or specialized suppliers. On the other hand, the author also points that specialized suppliers tend to favour bigger clients, either supplying them from long distances or locating nearby. The result of both facts is that market concentration reduces the availability of specialized supplies to smaller competitors. In short, according to the literature reviewed by Drucker (2011), higher market concentration makes more difficult the attainment of Marshallian economies of scale.

123 https://www.toyota-global.com/company/vision_philosophy/toyota_production_system/

we adjust these prices for the 13 years average exchange rate, and for sales tax`s differentials, Brazil moves towards the higher price portion of the sample, but it is still not on neither extreme.

Taking into consideration only the countries close to the minimum efficient level of scale at plant level, in conjunction with an analysis of the scale at model level, Brazil seems to be very close to the trend line that relates price and scale. Therefore, it seems that inside the factory, Brazilian competitiveness is relatively well explained by its scale. However, once a vehicle departs the factory, transport costs and other types of costs related to the business environment can take a toll on this competitiveness. These costs are the theme of the next subsection.

6.2 - EVOLUTION OF REAL PRICES OF CARS FROM 1989 TO 2019 AND POTENTIAL EXPLANATIONS

A brief note on import tariffs and the trade liberalization in the Brazilian automotive sector

Tariffs were elevated in the 1970s and up to 1989 cars and light commercials imports were prohibited. There were only minor exceptions, such as for vehicles used by foreign diplomats. Trade liberalization started in 1988 with the lift of several non-tariff barriers and a reduction in the tariffs average and standard deviation among tariff lines. In 1987 the average ad valorem tariff was 51%, the median 45% and the maximum 105%. In 1989 these values were lower: 35.5%, 35% and 85%, respectively[124].

In 1990 the government ended the prohibition of car imports. Initially, new and used cars could be imported, but later in the same year the import of used cars was prohibited. According to data from Anfavea, only 115 cars were imported by the automakers in 1990, number that jumped to 19.561 cars and 276 light commercials in

[124] Data from the Ministry of Trade (MDIC). Available at http://www.mdic.gov.br/images/REPOSITORIO/secex/deint/cgam/tec/tabela-e-grafico-da-evolucao-das-tarifas-nominais-de-importacao-do-brasil-1983-a-2016.pdf

1991[125]. This increase in imports is related to the reduction in tariffs, explained in table 7. Thus, 1991 can be seen as the first year of real import competition for vehicles.

Table 7 shows the tariffs applied since the ban on car imports was lifted, showing that the main reduction took place between 1990 and 1994 (from 85% to 20% tariff). In 1995 a reversal started, fuelled by balance of payments problems (in 1995 a record of 364,748 cars and light commercials were imported by Anfavea affiliates). The tariffs reached 70%, and later decreased again, to reach the current consolidated level of 35% in 1999.

Table 7 – Evolution of import tariffs applied to cars and light commercials in Brazil

Start date	Nominal import tariff applied
1980s	65%, 85% and 105%*
04/May/1990	85%
15/feb/1991	60%
01/feb/1992	50%
01/october/1992	40%
01/july/1993	35%
01/September/1994	20%
26/December/1994	20%
13/February/1995	32%
30/March/1995	70%
01/January/1997	63%
01/January/1998	49%
01/January/1999	35%

Sources: Several Decress and Resolutions listed in the Annex III.

*Up to 1990 the import of cars were prohibited, with only minor exceptions. The tarif was 85% for cars over 100 horse power and 105% for cars over 100 horse power. In 1989 the tariff was reduced to 65%.

Prices

There is a price index for new cars sold in Brazil, covering from July 1989 to the present day. It is the IPCA new vehicles, a subindex of the IPCA inflation index. However, probably due to the difficulties in collecting comparable vehicle prices in the long-term (when models and trims can encompass huge price variations), added to

[125] Anuario Anfavea 2018. Available at http://www.anfavea.com.br/anuarios.html

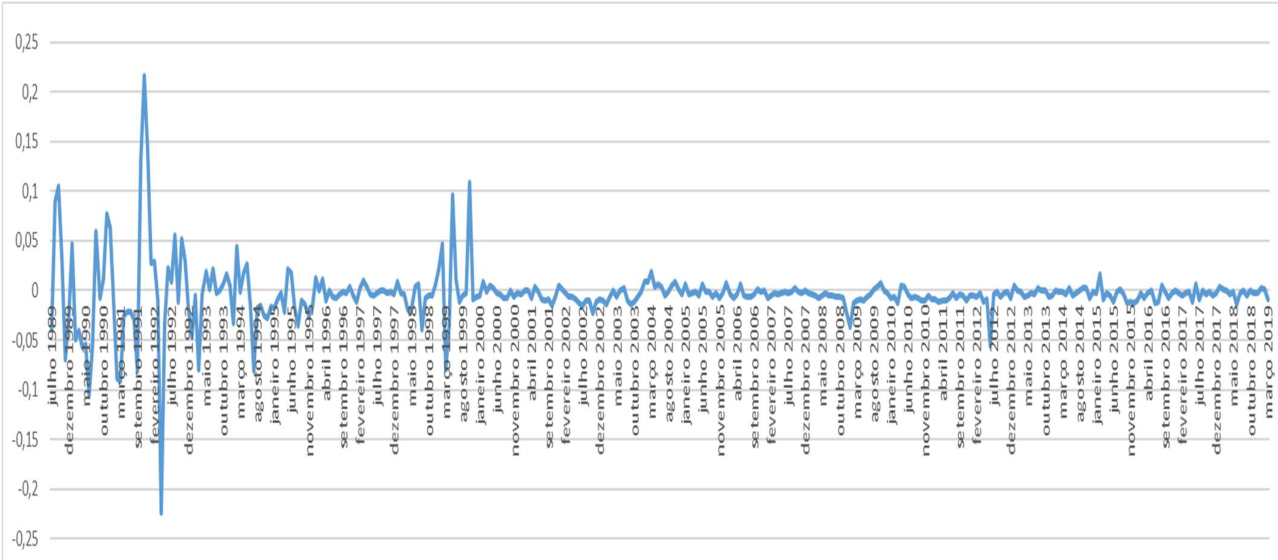
the very high inflation up to 1994, we suspect there are methodological problems in this price survey carried on by IBGE. When we deflated this series, using as deflator the whole IPCA index, the result is a 74% reduction in real prices between July 1989 and March 2019. Although several pieces of evidence (some discussed here) point to important real price reductions within this period of time, the magnitude showed by the IPCA index raises caution. Therefore, to check for the consistency of the data and to provide evidence of the behaviour of real car prices in Brazil, we will use three complementary data sources and approaches:

a) point data from specific models, available in the specialized press, for some years. This data is important to compare prices in the early years of the trade liberalization and the data collected allow us to have a clear notion of what happened with the same car model, in a time span of 2 years, thus not incurring in methodological problems related to different model specifications and also being able to cover the immediate period of trade liberalization;
b) data from FIPE/University of Sao Paulo, that has a car price index, covering prices of new models from January 2001 to the present date. This data does not cover the entire period of 1989-2019 but allow us to analyse price changes for each model that was manufactured in Brazil in 2001 and was still manufactured in 2019. We selected one or two trims of each of these models, and were able to gain important information regarding the effects of scale at firm level;
c) the quotient between total sales value and total vehicles sold, to get a proxy for the average sale price of vehicles. This will be adjusted by the market-share of vehicles under 1000cm3, as these vehicles are cheaper and pay substantially less tax.

IBGE IPCA Index

Monthly car and light commercials real prices oscillated intensively between July 1989 and July 1994, due to the high inflation experienced by Brazil. After 1994 inflation is controlled and real price variation only oscillated heavily in 1999 and 2000. Both periods of high fluctuation can generate potentially higher measurement errors. The period between oct/1991 and may/1992 is specially worrying in this sense.

Graph 4 – Historical monthly real price changes of new cars



We calculated the real price index for cars and light commercials making June 1989 =100. As a result, we arrived at an index of 25.68 in January 2019. Thus, in a period of 30 years, including the whole period of trade liberalization for cars, we had a real price reduction of 74.41%.

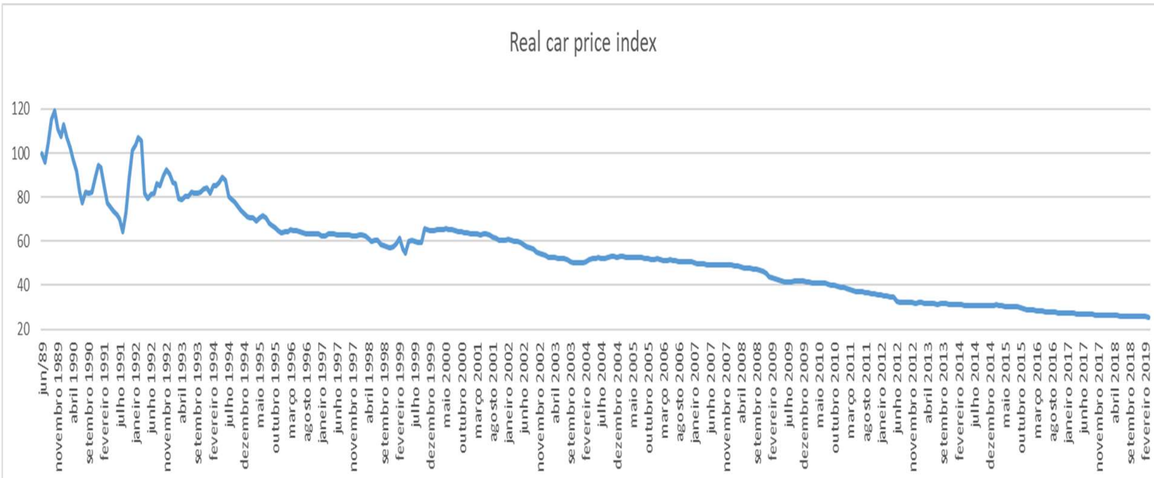
The formula for real price variation is:

$$(1 + real\ change) = [\frac{1 + nominal\ change}{1 + inflation}]$$

The car price nominal change accumulated in the whole period was 300.173.622,56%, while the inflation was 1.165.297.330,55%

Graph 5 shows the evolution of the real car price IPCA index. It can be seen that the index falls sharply from 1989 to 1995, despite a huge oscillation around 1992. After 1995 real car prices kept their decreasing trend, but at a smaller pace, with the exception of 1999, when real car prices increased. These overall movements can be explained by competition with imports: trade liberalization (allowing imports and reducing tariffs) happened between 1989 and 1985. The explanation for the 1999`s spike could rest on the exchange rate devaluation of that year, that reached 50% in real terms between December 1998 and March 1999.

Graph 5 – Real car price IPCA index



To check the robustness of the real price reduction results, we undertake three other measurement exercises.

a) <u>Price comparison of a same model between 1989 and 1992</u>

Anecdotical evidence found on the internet contains accounts of very high prices charged for vehicles before the trade liberalization process, and strong price falls following the first tariff reductions. These accounts, from the Brazilian specialized press, contains either prices updated using Brazilian price index IPCA or converted to US dollars, what is always problematic given the exchange rates fluctuations. According to one of these reports, a Volkswagen Gol GTi (a car smaller than a VW Golf), one of the four most expensive cars in Brazil, had a price tag in February 1989 of NCz$ 22,535.00, the equivalent to R$ 181,824.00 in December 2016[126]. The same car, in July 1992 cost Cr$ 65,900,000.00, the equivalent of R$ 121,737.00 in April

[126] Revista Quatro Rodas (2016). Teste QUATRO RODAS, published on 9 december 2016. Available at https://quatrorodas.abril.com.br/testes/grandes-comparativos-gol-gts-x-gol-gti/

2016[127]. As between April and December 2016 the car prices were virtually the same, we can conclude that between February 1989 and July 1992 (roughly 3 years) the price of a VW Gol GTi decreased 33% in real terms.

However, other factors besides import competition could have played a role in this price movement. To disentangle the effects of import competition lets first discharge any factor that probably did not play a role, and then, quantify the factors still valid. The factor that was discharged was movements in total demand: as domestic production in 1989 and 1992 were very similar, demand was probably not an important factor to explain the real price decrease within this period. The increase in demand and production following domestic taxes reductions happened only in 1993, thus not affecting the price comparison above. However, changes in domestic taxation and effective prices above the price list could have distorted this comparison. It could be affected by IPI tax reductions, and by other incentives under the sectoral agreements of 1992 and 1993, although the first agreement was signed only in July 1992[128]. Table 2 shows the IPI tax rates applied to vehicles of the category of the example used (Gol GTi).

[127] Revista Quatro Rodas (2016). Teste QUATRO RODAS, published on11 April 2016. Available at https://quatrorodas.abril.com.br/testes/uno-1-6-r-x-gol-gts-x-escort-xr3-x-gol-gti-x-kadett-gsi/

[128] In 1992 and 1993 the government and the private sector negotiated a series of tax reductions, investment and employment targets, and margins reductions. In 1993 the taxation on vehicles under 1cubic meter cylinders were reduced and this type of small car started to gain market-share (from 15.5% in 1992 to its all-time high of 69.8% in 2001). A new industrial policy (discussed in the literature review) were put in place between 1995 and 1997, attracting a great deal of new foreign investments.

Table 8 – Changes in the excise tax (IPI) on cars with 2,0 cubic meters petrol cylinder – 1988 to 1993 (tax codes 8703.23.01 and 8703.23.02

Year	Vehicle specification	Tax rate	Start date	Decree
1988	less than 100hp	45%	23/december/1988	DECRETO No 97.410, DE 23 DE DEZEMBRO DE 1988.
	more than 100hp	**50%**	23/december/1988	
1989	less than 100hp	33%	01/april/1989	DECRETO No 97.598, DE 30 DE MARÇO DE 1989.
	more than 100hp	38%	01/april/1989	
1989	less than 100hp	37%	15/march/1990	DECRETO No 99.182, DE 15 DE MARÇO DE 1990.
	more than 100hp	42%	15/march/1990	
1991	less than 100hp	27%	08/july/1991	DECRETO No 173 DE 8 DE JULHO DE 1991.
	more than 100hp	32%	08/july/1991	
1991	less than 100hp	22%	06/septmber/1991	DECRETO No 207, DE 6 DE SETEMBRO DE 1991.
	more than 100hp	32%	06/septmber/1991	
1992	less than 100hp	31%	31/march/1992	DECRETO No 483, DE 31 DE MARÇO DE 1992.
	more than 100hp	**36%**	31/march/1992	
1993	less than 100hp	25%	19/feb/1993	DECRETO No 755, DE 19 DE FEVEREIRO DE 1993.
	more than 100hp	30%	19/feb/1993	

Sources: Legislation database at the Brazilian Presidency (http://www4.planalto.gov.br/legislacao/)
The Decree 97410/1988 (http://www.planalto.gov.br/ccivil_03/decreto/1980-1989/D97410.htm) has links to the subsequent Decrees

Notes: (1) Tax rates applied to vehicles classified under the codes 8703.23.01 and 8703.23.02, on the IPI table valid for those years. Other tax rates were applied to other vehicle specifications/classifications.
(2) Decree 799, from 17/April/1993 reduced to 0,1% the IPI tax rate on vehicles under 1000 cm3 cylinder capacity.

It can be seen that in February 1989 the IPI rate was 50%, while in July 1992 was 36%. To disentangle the effects from the evolution of IPI rates, we calculated the price change deducting the amount of IPI, in both years (1989 and 1992) and then calculated the percentual change:

$$UPWT1989 = UP1989 * (1 + IPI\ rate1989)$$

Where:

UPWT1989 = Updated Price including IPI tax of the VW GTi 1989

UP1989 = Updated Price without IPI tax of the VW GTi 1989

IPI rate1989 = IPI tax rate applied in 1989

The same for the VW Gol GTi 1992:

$$UPWT1992 = UP1992 * (1 + IPI\ rate1992)$$

Where:

UPWT1992 = Updated Price including IPI tax of the VW GTi 1992

UP1992 = Updated Price without IPI tax of the VW GTi 1992

IPI rate1992 = IPI tax rate applied in 1992

As we know the updated prices and the IPI tax rates of both cars we do a simple algebra to get:

UP1989 = Updated Price without IPI tax of the VW GTi 1989 = 121,220.00

UP1992 = Updated Price without IPI tax of the VW GTi 1992 = 89,510.00

The percentual reduction is therefore 26.2%, net of the IPI tax change.

Exchange rates did not affect the results, as real prices were calculated using domestic currency price indexes. Neither the fact that the prices charged by dealers in 1992 were usually higher than the price list of the automakers, as consumers used to buy cars to protect themselves against inflation on those years: the important price in our analysis is the price charged by automakers.

b) Price comparison between selected models from 2001 to 2019

At the FIPE website it is possible to see prices of new cars since January 2001. Although it is a shorter time range, it allows for a time comparison per model, thus avoiding problems related to index aggregation. For this, we chose all models that were continuously manufactured in Brazil, from January 2001 to January 2019, accepting only minor changes in the specifications and the obvious facelifts or new generations of the model (if it does not reposition the model in the market). Table 9 brings all data used in this subsection.

Table 9 – Car price variation, selected models (2001 to 2019)

Models	Current (historical) price in January 2001 (automaker suggested retail prices)	Current (historical) price in January 2019 (automaker suggested retail prices)	Current (historical) price in January 2019 (average dealer price)	Difference between automaker suggested retail price list and average dealer price	Nominal change (automaker suggested retail prices)	**Real change based on automkare`s list (assuming general inflation of 205% between Jan/2001 and January/2019**	Nominal change (average dealer price)	**Real change based on dealer`s list (assuming general inflation of 205% between Jan/2001 and January/2019**
2001 Fiat Palio Weekend Sport 1.6 mpi 16V 4p	R$ 29.209,00							
2019 Fiat Weekend adventure 1.8		82.990,00	76.900,00	-7,34%	184,12%	**-5,99%**	163,28%	**-12,89%**
2001 Fiat Uno Mille/ Mille EX/ Smart 4p	R$ 12.959,00							
2019 Fiat Uno 1.0 Attractive		44.590,00	42.990,00	-3,59%	244,09%	**13,85%**	231,74%	**9,76%**
2001 Fiat Strada/ Strada Working 1.5 mpi 8V CS	R$ 15.374,00							
2019 Fiat Strada 1.4 working CS		51.990,00	49.290,00	-5,19%	238,17%	**11,89%**	220,61%	**6,08%**
2001 GM Celta 1.0/1.0 MPFi VHC 8V 3p	R$ 14.618,00							
2019 GM Onix 1.0 flex LT		47.090,00	48.150,00	2,25%	222,14%	**6,59%**	229,39%	**8,99%**
2001 GM Corsa Wind 1.6 MPFi 4p	R$ 19.696,00							
2019 GM Onix 1.4 flex LTZ		58.190,00	58.990,00	1,37%	195,44%	**-2,25%**	199,50%	**-0,90%**
2001 GM Vectra GLS/ Challenge 2.2 MPFI 16V	R$ 42.634,00							
2019 GM Cruze 1.4 turbo LTZ		108.290,00	109.790,00	1,39%	154,00%	**-15,96%**	157,52%	**-14,79%**
2001 GM S10 Pick-Up 2.4 MPFI 8v 128cv CD 4p	R$ 38.203,00							
2019 GM S10 CD 2.5 4x2 advantage		105.990,00	93.000,00	-12,26%	177,44%	**-8,20%**	143,44%	**-19,45%**
2001 Honda Civic Sedan EX 1.6 16V Aut. 4p	R$ 45.707,00							
2019 Honda Civic 2.0 flex EX		102.400,00	99.900,00	-2,44%	124,04%	**-25,87%**	118,57%	**-27,68%**
2001 Peugeot 206 Rallye 1.6	R$ 27.261,00							
2019 Peugeot 208 allure 1.2		64.690,00	61.209,00	-5,38%	137,30%	**-21,48%**	124,53%	**-25,71%**
2001 Renault Clio RL / Yahoo/ Authent. 1.0 8V 5p	R$ 17.265,00							
2019 Renault Kwid 1.0 life		32.490,00	32.500,00	0,03%	88,18%	**-37,73%**	88,24%	**-37,72%**
2019 Clio Sedan RN/ Expression 1.6 16V 4p	R$ 25.795,00							
2019 Renault Logan 1.6 expression		58.490,00	57.900,00	-1,01%	126,75%	**-24,97%**	124,46%	**-25,73%**
2001 Toyota Corolla XLi 1.8/1.8 Flex 16V Aut.	R$ 34.727,00							
2019 Toyota Corolla 1.8 Gli automatic		90.990,00	79.900,00	-12,19%	162,02%	**-13,31%**	130,08%	**-23,87%**
2001 Toyota Corolla XEi 1.8/1.8 Flex 16V Aut.	R$ 35.649,00							
2019 Toyota Corolla 2.0 Xei		105.990,00	102.000,00	-3,76%	197,32%	**-1,63%**	186,12%	**-5,33%**
2001 Toyota Corolla SE-G 1.8/1.8 Flex 16V Aut.	R$ 44.890,00							
2019 Toyota Corolla 2.0 Altis		118.990,00	110.000,00	-7,56%	165,07%	**-12,30%**	145,04%	**-18,92%**

Source: FIPE - USP.

The weighted average (based on units sold in January 2019) real change, based on dealer`s average price list was -7,29%, from January 2001 and January 2019. It is important to notice that both 2000/2001 and 2018/2019 production levels happened in crisis` years (2000-2001 GDP, 2018GDP). Therefore, we assume demand changes did not play an important role for those prices. Moreover, domestic taxation (IPI, ICMS and PIS/COFINS) was similar in both periods. The same can be said for the real effective exchange rate and for import tariffs. Thus, the real price variation obtained here can potentially be mainly attributed to both increases in scale and/or domestic competition. A carefully and detailed examination of the results ate firm and model levels allow us to make some considerations about these effects:

The cheapest cars – with 1,0-cylinder capacity, produced by the traditional automakers (GM and Fiat, established in the country for decades and with a dominant market-share, together with Volkswagen) increased in price. In the same period, the market-share of 1,0 cars was reduced in half. Thus, their relative scale of production was reduced. Their absolute scale of production was also reduced: from 69,8% market-share in 2001 (920 thousand cars) to 35,3% market-share in 2018 (741 thousand cars)[129]. However, we need to look at firm-level or model-level scale to analyse the scale effects. For example, the Renault 1,0 cylinder in the sample was the biggest price decrease.

There is a correlation between increases in scale and decreases in process, at firm-level. Although the data does not allow us to confirm the direction of the causality, it is reasonable to assume that lower prices generated more scale and more scale allowed lower prices, in a mutual reinforcing movement.

The automakers Fiat and GM had a very small increase in scale, and, on average, a much less pronounced price reduction. On the other hand, the newcomers (Honda, Peugeot, Toyota and Renault) had a sharp increase in scale and a decrease in average real prices:

[129] Anuario Anfavea 2019.

Table 10 – Average growth in production and prices between 2001 and 2018: incumbent and newcomers

		average growth in vehicle production - %	average growth in vehicle production - unities	average real price change
Traditional automakers		2,77%	8992	-2,78%
Newcomers:		623,29%	147604,5	-25,29%

A closer look, at firm-level, shows that price variation and the change in number of units are highly correlated. In fact, correlation between production increase (quantity) and price was a strong -0,59.

Table 11 – Percentage and unit growth in production versus price change – selected automakers (2001 and 2018)

Assembler	2001	2018	Percentage growth	Assembler	Growth in units	Price change
GM	509.411	466.445	-8,43%	GM	-42.966	-6,54%
Fiat	436.218	497.168	13,97%	Fiat	60.950	0,98%
Toyota	14.649	209.384	1329,34%	Toyota	194.735	-16,04%
Peugeot	18.116	77.636	328,55%	Peugeot	59.520	-25,71%
Honda	22.058	137.983	525,55%	Honda	115.925	-27,68%
Renault	71.108	291.346	309,72%	Renault	220.238	-31,72%

Fiat total car production: 385,000 in 2001 to 333,000 in 2018;
GM total car production: 452,000 in 2001 to 400,000 in 2018;
Fiat total car light commercial production: 51500 to 164000;
GM light commercial production: 57000 to 66000.

The mid-sized cars, from brands that had smaller scale in the 1990`s and 2000`s, showed an important price reduction as those automakers gained scale:
Honda: 22000 in 2001 to 138000 in 2018;
Toyota: 13000 in 2001 to 209000 in 2018.

Meanwhile, smaller vehicles from brands that also gained scale, also had important price drops:

Renault: 71000 in 2001 to 243000 in 2018;
Peugeot: 18000 to 78000.

c) **Total sales divided by number of vehicles sold**

The quotient between net industrial sales value[130] and total sales of new domestically produced cars and light commercials give us a proxy for the average sale price of vehicles. As this average price can change because of a change in the sale mix (with more or less participation of cheaper or more expensive cars) we will provide a comparison with the evolution of market-share of vehicles under 1000cm3, as these vehicles are substantially cheaper. Moreover, it is important to note that dealers`margins are not considered into the calculations. Therefore, to compare with the other data sources we are using in this chapter we are assuming that dealer`s margins were constant from 1996 to 2017.

Data is only for firms producing in Brazil and covers 1996 to 2017. Before 1996 data for net sales revenue from Anfavea aggregates cars, light commercials, trucks and buses, and there is no data at PIA/IBGE available for net industrial turnover for before 1996. Moreover, as the monetary stabilization in Brazil happened in 1994, data in nominal currency is more reliably converted into real values if it is after 1995. Data on sales of new vehicles (units), domestically produced, is available from Anfavea, from 1957 to 2018, as are data on the participation of 1000cm3 cylinder cars.

The results are in the table 12 and in the graph bellow:

[130] "Receita líquida de vendas" in portuguese. It is equal the gross industrial turnover minus deductions for returned vehicles, discounts, and taxes (IPI, ICMS, ISS, and PIS/COFINS). The data is for cars and light commercials, as available in PIA/IBGE.

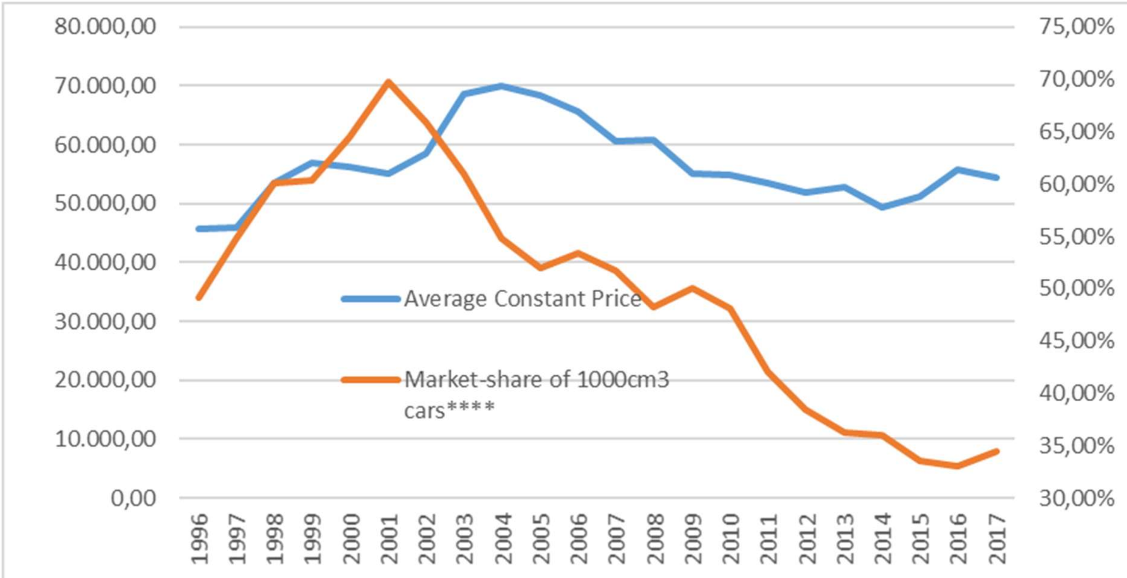
Table 12 – Average constant car prices based on turnover and sales

Year	Net Industrial Turnover (current R$ thousands)*	Constant Net Industrial Turnover (R$ thousands of 2016, deflated by IPCA)	Sales of new domestically produced cars and light commercials (units)**	Average Constant Price	IPCA Index 01/01/1996 =100***	Market-share of 1000cm3 cars****
1996	18.950.471,00	66.374.696,25	1.453.621,00	45.661,62	109,56	49,20%
1997	21.700.783,00	72.236.990,59	1.573.847,00	45.898,36	115,28	54,80%
1998	18.377.023,00	60.179.976,88	1.122.590,00	53.608,15	117,18	60,10%
1999	19.347.195,00	58.157.736,53	1.020.635,00	56.981,91	127,66	60,40%
2000	24.553.539,00	69.649.924,50	1.237.296,00	56.292,05	135,28	64,50%
2001	27.909.493,00	73.529.868,04	1.335.666,00	55.051,09	145,65	69,80%
2002	32.059.663,00	75.058.948,03	1.283.264,00	58.490,65	163,90	65,90%
2003	40.858.688,00	87.520.094,03	1.274.556,00	68.667,12	179,15	61,00%
2004	49.880.525,00	99.298.366,23	1.420.025,00	69.927,20	192,76	54,80%
2005	55.777.016,00	105.058.807,19	1.534.628,00	68.458,81	203,73	52,00%
2006	60.800.090,00	111.033.565,07	1.693.100,00	65.580,04	210,13	53,40%
2007	71.790.087,00	125.506.009,24	2.067.460,00	60.705,41	219,50	51,70%
2008	84.763.530,00	139.930.735,01	2.300.116,00	60.836,38	232,45	48,30%
2009	88.006.436,00	139.281.222,15	2.523.188,00	55.200,49	242,47	50,10%
2010	98.060.273,00	146.532.603,24	2.671.413,00	54.852,10	256,80	48,10%
2011	98.161.643,00	137.731.532,02	2.571.869,00	53.553,09	273,49	42,10%
2012	111.668.263,00	148.037.413,65	2.850.509,00	51.933,68	289,46	38,50%
2013	121.364.653,00	151.913.713,01	2.876.423,00	52.813,41	306,57	36,30%
2014	114.220.216,00	134.358.545,62	2.718.542,00	49.423,02	326,22	36,00%
2015	99.470.470,00	105.727.162,56	2.067.634,00	51.134,37	361,03	33,50%
2016	95.804.438,00	95.804.438,00	1.716.989,00	55.797,93	383,74	33,00%
2017	112.231.516,00	105.075.934,05	1.933.678,00	54.339,93	409,87	34,50%

*"Receita liquida de vendas". Source: PIA Empresa, IBGE
** "Licenciamento de autoveiculos novos nacionais". Source: Anfavea
***Based on data from IPEADATA
**** Source: Anfavea

Vehicles` price increased 53,14% in real terms between 1996 and 2004. As the market-share of smaller cars were on the rise, this increase in price is probably underestimated. On the other hand, between 2004 and 2017 real prices decreased by -22,29%. As the market-share of smaller cars were going down, this decrease in price is also probably underestimated. Overall, between 1996 and 2017, real prices would have increased by 19%. However, if we look at the evolution of the market-share of 1,0-cylinder vehicles (the cheapest ones) it felt from more than 50% in 1996-1997 to around 34% in 2016-2017 (graph 6). Thus, the real price increase is probably overestimated: as the market-share of smaller vehicles decreased, the units sold were of a bigger (and usually more expensive) category.

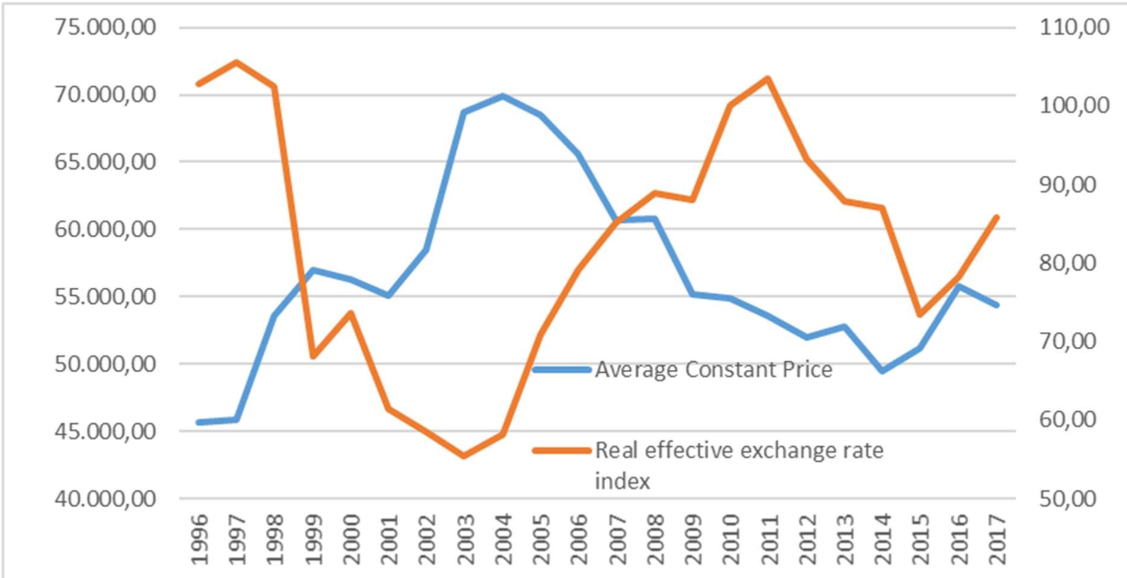
Graph 6 - Relationship between constant prices and market-share of small cars



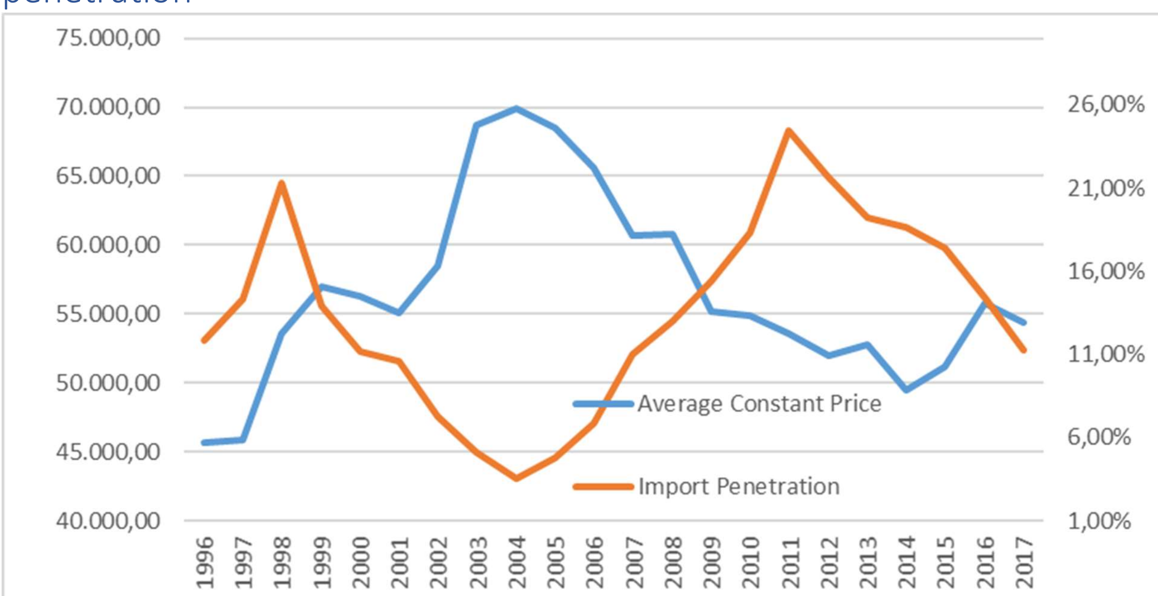
It is important to remember that this calculation is free from the effects of changes in IPI taxation. What can be said with confidence is that real car prices rose between 1996 and 2004 and decreased between 2004 and 2014. This behaviour is consistent with the exchange rate movements, as depicted in graph 7. A fall in the exchange rate index means a devaluation of the Brazilian Real. Thus, we can see that in periods of Brazilian currency appreciation car prices are reduced, and in periods of Brazilian currency depreciation, car prices increase. The import tax was reduced from 1996 to 1999 and stayed at the same level since them. This suggests that variations in the exchange rate had an effect on domestic car prices. On graph 8 we can see that exchange rate movements match import penetration, thus supporting the conclusion that competition with imports had an important impact on domestic price behaviour.

Graph 8 also allow us to see that between 1996 and 1999 import penetration rose – despite the relative stability of the exchange rate – because the import tariffs were reduced from 70% in 1996, to 63% in 1997; 49% in 1998, and finally 35% in 1999. But overall, when the Brazilian currency loses value, domestic prices rise, and when the currency gains value, domestic prices fall. The channel for this to happen is likely to be the imports, as we can see from Graph 6.

Graph 7 - Relationship between constant prices and real effective exchange rate index



Graph 8 - Relationship between constant prices and import penetration



Thus, competition from abroad seems to be a driver for domestic prices, and the current import tariff level (35%) seems to be not enough to annulate the effects of exchange rates: when imports rise, domestic prices fall, and when imports fall, domestic prices rise (graph 8). Combining graphs 7 and 8 we clearly see that movements in the exchange rates alter import penetration and then domestic prices, at least after 1999.

<u>Conclusions from this section</u>

The results from the first price comparison suggest a real price reduction of 33% from February 1989 and July 1992 (here we are not disentangling the effects of changes in taxation). The IBGE/IPCA data does not cover the period between February 1989 to June 1989 but taking into consideration the period of July 1989 to July 1992, the IBGE data points to a real price reduction of 19%. In this sense, IBGE data seems not to be overstating the price reduction. However, as we analysed only a specific high-end model, arguably more affected by imports of better and more advanced cars, it could be the case that cheaper models had a smaller price decrease.

The results from the second price comparison suggest a weighted average real price reduction of 7,29% between January 2001 and January 2019. However, the IBGE data for the same period points to a real price reduction of 60%. For these 18 years` period IBGE data do seems to be seriously overstating the price reduction.

As explained by IBGE in their Nota Tecnica n. 01/2000, up to August 2000 the price estimation for new cars used the retail price list suggested by the automakers. Since them, IBGE used prices collected in dealers. As we used prices collected in dealers as well, this would not be the reason for the discrepancy. The only potential reason we can think of to justify such discrepancy in the data is that IBGE used a different basket of models, and different weights. The combination of other models and other weights can generate important differences, but this could be in both ways, and so it is very difficult for this explanation alone to justify such difference.

The third comparison, when we calculate a proxy for the average price, based on net turnover divided by units sold, delivers a potentially small real variation between 1996 and 2017, if we consider the change in the sale model mix. If we use the time range from 2001 to 2017, thus similar to the second comparison, we would have nearly flat real prices (in contrast with the 7% reduction found in the second comparison, that is free from problems related to sales mix).

Despite the magnitude of the numbers, their direction and correlations would suggest that the real price reductions were concentrated in the years of trade liberalization (1990-1994), and after 2004, when the automakers that came to Brazil in late 90s and early 2000s started to gain scale. Exchange rates also seems to have contributed to the real price behaviour, adding to the effects of tariffs. Thus, data from prices indicates a degree of competition within the domestic market and with imports. The oligopoly structure would be non-collusive, from this perspective. The next subsection takes a closer look on indicators of concentration and market-power, to gain further insights.

If after 1999 import penetration is driven by exchange rate changes, the tariff level of 35% from 1999 to 2011 and of 35% plus the extra IPI tax on imports, brought by Inovar-Auto, from 2011 to 2017, is innocuous. This could have happened because before 2010 most automakers without plants in Brazil were not actively seeking the Brazilian market, and after 2010, when they started to direct their exports to the Brazilian markets (mainly the Chinese) the government set up the Inovar-Auto extra tariff, thus frustrating most of the Chinese imports. The bulk of imports after Inovar-Auto came from automakers with operations in Brazil, under quotas free of the extra taxation imposed by Inovar-Auto. Therefore, these intra-firm imports were sensitive to the exchange rate fluctuations, while the Chinese imports were virtually blocked by the sum of 35% import tariff and the extra 35% IPI from Inovar-Auto. From another perspective, this suggests that there would be water in tariff for tariff levels above a level between 35% and 70%.

6.3 - INDUSTRIAL ORGANIZATION BACKGROUND AND THE EFFECTS OF TRADE PROTECTION ON THE BRAZILIAN AUTO INDUSTRY

In this subsection we are interested in knowing (i) the evolution of domestic competition levels in the Brazilian automotive sector and (ii) the evolution of competition with imports. To assess these two questions, we will gauge the market power of Brazilian automakers since the 80`s, using concentration indexes, and compare this with the level of import penetration and the evolution of trade tariffs and exchange rates.

Before going to data analysis, we need to state the case for the concentration indexes and for the market structure under analysis. The Industrial Organization branch of Economics mainly studies how firms behave (or compete) under imperfect competition. It advances from simpler perfect competition and monopoly models, usually dealt with standard microeconomics. Therefore, it models market structures such as oligopolies and monopolist competition and provides insights on the appropriate policies to tackle market power and to increase efficiency[131].

At an aggregated level, monopoly power results in charging prices above the marginal costs, and, therefore, above the prices that would prevail under perfect competition. These higher profits received by the monopolist firm are, however, smaller than the losses suffered by consumers. In a static framework, this difference is the result of an inefficient allocation of resources and gives rise to a welfare loss. The size of this welfare loss is the so-called "deadweight loss". In a dynamic framework the results can be quite different, as the monopoly power (or the expectancy of that) can eventually lead to more investments, innovation, and scale gains, for example.

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[131] As presented in the conceptual framework of this thesis, efficiency correspond to the best use of resources, and in Economics it can be divided into two main types: allocative efficiency (obtained when price equals marginal cost and thus the economy is producing the goods and services that the consumers want, at the quantity and price they want – their marginal utility); and productive efficiency (firms producing at their lowest average cost).When firms produce at their lowest long-run average cost there is the productive efficiency of the type efficiency of scale. X-inefficiency arises when a firm does not increase its productive efficiency but can still survive, as it is not threatened by competition.

The automotive sector is usually depicted as an example of oligopoly around the world, with differentiated products, mainly because the high fixed costs that provide an important entry barrier to new firms. In this case, their prices are setup following a strategic approach taking into consideration the moves of each competitor. However, if technology changes allow a sufficient decrease in the minimum scale of production, and suppliers provide sufficient technological support for newcomers, more automakers could enter the market. If this reduction in entry barriers is enough to counteract the consolidation among the current players, the market structure of the industry could shift to something more like a monopolistic competition[132]. Arguably, this is not yet the case, as most automakers show positive economic profits (contrary to the monopolistic competition, where in the long-run firms tend to face a zero-profit equilibrium). Toyota, for example, keep delivering net profits higher than usual measures of opportunity costs[133].

An oligopoly is characterized by fewer firms, in a market with entry barriers that could be generated by all sorts of factors, including, for example, economies of scale, regulation, and product differentiation[134]. Under both market structures is possible to have intense competition, either by price, by product, or by a combination of both. If they collude, oligopolists can increase their profits close to monopoly levels. This collusion can be tacit or formal and is facilitated when the domestic market is relatively closed, as imports do not threat the tacit arrangement among domestic producers.

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[132] The luxury car segment, for example, is clearly an oligopoly, as very few firms dominate the market, but for the overall car production the discussion if the market structure is an oligopoly or a monopolistic competition is possible. Monopolistic competition is characterized by many firms competing in a market but able to charge different prices because of product differentiation. Their market power is proportional to the degree of product differentiation they can provide.

[133] As in the 6-months financial report summary consolidated in 6 November 2018, Toyota Motor Corporation has 52.5 trillion yens in total assets and generated a net income of 1.24 trillion yens. This represents a 2.36% in six-months. To gauge the opportunity costs, we assume that the total assets could be invested in a reduced-risk government bond, such as the Japanese 30-year bond, or the U.S. 30-year-bond. According to the financial data provider Bloomberg (Bloomberg, 2019), the current annualized yield for this Japanese bond is 0.66%, while the current annual yield for the north American counterpart is 3.06%. The positive difference between Toyota`s net profit (2.36% in six months) and the chosen bond yield (roughly half of either the 0.66% or the 3.06%, to arise at 6-months yields) is an indication of economic profits.

[134] One characteristic of an oligopolized market structure is that the behaviour of each firm is very dependent on the perceived or forecasted behaviour of each one of its competitors in that market. The New Industrial Organization economics use game theory to analyse different models of imperfect competition and thus trying to describe how markets function under different structures and how market structures change given firms` performance and behaviour.

A firm is said to have "market power" when it is able to charge prices higher than marginal costs in a sustainable way. Differently from the perfect competition model, in an imperfect competition model the demand curve has a downward sloping, meaning that for each price reduction there would be an increase in the demanded quantity. The highest profit is made when the firm maximizes the difference between total revenues and total costs. The less price-sensitive a consumer is, the higher the scope for monopolists to rise prices. In other words, a lower demand elasticity allows for higher mark-ups over marginal costs.

As known, in a market we can find more than one firm with some degree of monopoly power, not necessarily one monopolist. In this sense, a measurement of the monopoly power – or, more broadly, "market power", is welcomed. Firms facing a demand curve with demand elasticity less than infinite would have some monopoly power. A widely used measure of monopoly power is simply the mark-up level charged by the firm. This is the so-called Lerner index:

$$Lerner\ Index = markup\ level = \frac{\mathrm{P} - \mathrm{MgC}}{\mathrm{P}} = 1 - \frac{MgC}{P}$$

The highest the index, the highest the monopoly power. At first, it is reasonable to assume, as a simplification, that the lowest the number of competitors in the market, the highest will be their market power. This is a result both from the fact that less firms mean smaller elasticity of supply; and from the fact that with fewer firms each demand curve would be less elastic. Nevertheless, other factors can play a role and the result can be different from just considering the number of firms. Two main examples can be (i) strategic interactions among firms, such as cartels and (ii) potential entry of competitors, keeping the market price lower, even if the competitors do not effectively enter the market.

Market power can be gauged by market concentration (under the so-called "structure performance hypothesis"), or by market-shares measures (under the so-called "efficiency structure hypothesis"). Market concentration allow firms to act strategically, including through collusion. On the other hand, higher market-shares can be viewed as a result of previous cost-advantages (efficiency). Furthermore, bigger firms have competitive advantages in terms of scale or access to technologies and inputs, for example.

Market-share can also be a proxy for firm-level productive efficiency. Therefore, the evolution of market-shares can give us an idea about the dynamics of the market: markets where firms` market-shares vary through time can be an indication of a more competitive environment; and markets with higher concentration – and thus higher market-shares for the leading firms – allow for higher economies of scale (and thus productive efficiency).

As explained by Bresnaham (1987), empirical estimations of market power can be of two main types: a) explicit indicators, such as price-cost margins; and b) estimation of structural equations of supply and demand.

Bresnaham (1987) consider the use of some explicit indicators as unsuitable for single industries, because they rely on accounting concepts that barely can be used as proxies for the economic variables. He gives the example of profits, that can be affected by accounting rules, related to how fixed costs would be spread over time.

The indicators we are using in this study are not related to accounting ones. Market-shares, concentration indexes and price differentials are all "economic" concepts, free from the criticisms found in Bresnaham (1987). However, even profitability and mark-ups could be used, provided some conditions are met. Mark-up levels, for instance, are a case "in between" an accounting and an economic variable: if revenue and costs reflect the economic revenue and costs for that time, mark-ups would be a reliable economic variable. Otherwise, it would suffer from the same problems as the profit measure.

As said in the beginning of this subsection, we are interested in evaluating the degree of domestic and foreign competition for the industry in Brazil. Implicitly, we are testing three hypotheses[135]:

[135] Among the game models used in the literature to analyse the behaviour of an oligopoly with product differentiation and tacit collusion there is the kinked demand curve. According to this model, oligopolist firms do not rise prices, because the other firms would not follow and then the firm would lose market-

a) domestic firms act cooperatively (in this case, a tacit collusion) and are protected from foreign competition;
b) domestic firms act non-cooperatively (no tacit collusion), but are still protected from foreign competition;
c) domestic firms act non-cooperatively (no tacit collusion) and are not effectively protected from foreign competition.

For a cooperative oligopoly we would then expect relatively stable market-shares, concentration ratios and price movements. Even given that competition in the industry is heavily based on quality, oligopolies are usually characterized by a relative price stability[136]. However, any measure of price alone could be misleading. In this sense, we will use measures of market power (market-shares and concentration ratios), as these capture the effects of the combination of prices and quality (product differentiation).

Two potential complications are: (i) when a specific producer is hit heavier by imports, thanks to the type of models it produces; and (ii) it may be the case that a domestic producer changes its prices because it wants to reposition itself, accepting/seeking a correspondent change in market-share.

We will then provide the evolution of domestic market-shares, concentration indexes (C4 and HHI), import penetration, number of brands, total production, prices and currency movements, calculate the correlations and analyse the evolution of each indicator through time. The variables we use are the following:

share. They also do not reduce prices, because in this case other firms would do the same, thus impeding any gain of market share and reducing the overall profit. Given its results, this model could well explain a tacitly collusive oligopoly. The Brazilian automotive sector is viewed by the public as an example of this structure. As we already mentioned, barriers to entry (in our case, trade protection) can help this behaviour to happen. So, a market sufficiently protected could display oligopolistic firms making economic profits thanks to a tacit collusion where market shares are kept fixed and prices stable. If automakers in Brazil behave this way, we would have a suggestion of trade protection reducing domestic competition. This finding would be adding to the canonical fact that trade protection reduces competition from abroad. And, assuming that competition is a positive driver for competitiveness, we would have an indication that trade protection damages competitiveness in the Brazilian auto-sector through the channel of reducing domestic competition.

[136] The exception being mainly what is conventionally known as “price wars”.

Market-shares

Market-shares of the domestic producers

Concentration indexes

C4 = the total production of the 4 biggest firms, in relation to the total market production

HHI = $\sum_{i=1}^{n} s_i^2$

Where "n" = number of firms in the market; "s" = market share of each firm "I"

Import penetration

The import penetration coefficient shows the percentage of domestic consumption that is supplied by imports.

$$Import\ penetration = \frac{imports}{(production + imports - exports)}$$

Real effective exchange rate

The real effective exchange rate is weighted average of the nominal exchange rate against trade partners, adjusted by inflation in all trade partners and in the domestic country.

Constant prices of new cars

Nominal index of prices of new cars deflated by the overall price index IPCA

Real variation of prices for new cars

Variation of the prices of new cars in constant prices.

<u>The domestic market</u>

Table 13 brings an overview of the production of cars and light commercials in Brazil, emphasizing the market-share and average scale of each producer, and comparing their evolution between 2013 and 2018.

Table 13 – Automakers operations in Brazil

Automaker operations in Brazil - cars and light commercials							
Automaker	Start of production in Brazil	Production in 2013	Production in 2018	Number of plants producing cars, light commercials, engines and other parts***	Number of plants producing cars and light commercials, with metal bodies	Average scale per plant in 2013	Average scale per plant in 2018
Ford	1957	333.124	267.758	3(BA;SP)+1(CE) for Troller	2	166.562	133.879
GM	1957	680.737	466.445	5(SP;SC;RS)	3	226.912	155.482
Volkswagen	1957	761.193	433.466	4(SP;PR)	3	253.731	144.489
Fiat-Chrysler (FCA)	1976	756.717	497.168	3(MG;PE; PR)	2	378.359	248.584
Toyota	1959	129.653	209.384	4(SP)	2	64.827	104.692
Honda	1997	135.065	137.983	2 (SP)	2	67.533	68.992
Mitsubishi and Suzuki (MMC/HPE)*	1998 (2013)	43.101	22.363	1(GO)	1	43.101	22.363
Renault	1999	282.595	291.346	4(PR)****	1	282.595	291.346
Mercedes-Benz**	1999 (2016)	0	7.620	Up to 2010: 1(MG). After 2016: 1 (SP)	1	0	7.620
Peugeot-Citroen	2001	143.634	77.636	2(RJ)	1	143.634	77.636
Nissan	2002	26.809	104.317	1(RJ)	1	26.809	104.317
Hyundai-Subaru (CAOA)	2007	35.117	14.792	1 (GO)	1	35.117	14.792
Hyundai	2012	166.269	191.646	1 (SP)	1	166.269	191.646
BMW	2014	0	8.563	1(SC)	1	0	8.563
Audi	2015	0	4.942	1(PR)	1	0	4.942
Cherry (CAOA Cherry since 2017)	2015	0	8.634	1(SP)	1	0	8.634
Jaguar-LandRover	2016	0	4.295	1(RJ)	1	0	4.295
Totals		3.494.014	2.748.358		25	154.621	93.663

* Suzuki models were manufactured at the plant from 2013.
** Between 1999 and 2010 it produced the small class-A, in Minas Gerais. Since 2016 it produces the class C and the GLA in a new plant in Sao Paulo.
Anfavea production data for this Mercedes plant is not available. Instead, we use data for registration of nationally manufactured vehicles for these years.
These numbers can be sligthly smaller than the production figures because they do not account for any vehicle eventually exported, for example.
*** It does not include proving grounds, distribution centers and plants producing solely trucks, buses or agricultural machines.
****Sharing a manufacturing unit with Nissan.
Sources: Anuario Anfavea 2019 and Abeifa (http://www.abeifa.com.br/Mercado)

The pioneers Ford, GM, Volkswagen and Fiat dominated the domestic market for most of the time. Only in the late 2010s automakers such as Toyota, Honda, Renault, Nissan and Hyundai changed this picture. Toyota was a pioneer as well, but in the 50s, 60s, 70s and 80s it only manufactured light commercials. Only in 1998 it started to manufacture the Corolla in Brazil, thus effectively entering the domestic car market.

Average scale per plant that produces cars and light commercials (excluding the plant that produces the light commercial Troller, with a non-metal car body) was 155 thousand in 2013, high before the economic crisis, and before the new entrants started production, following the incentives of Inovar-Auto. In 2018 this average scale went down to 94 thousand.

There are different types and levels of partnership among automakers, including small technical collaborations, partial cross-ownerships, mergers, joint product development, joint input purchases etc. We then also calculated the concentration coefficients and other variables considering the partnerships that made brands behave as if they were one, either by sharing facilities, ownership control or being subsidiaries or representants of the same brand. Taking into consideration only the brands that had production in Brazil, even for part of the period under analysis, we then make the following partnership considerations among car brands:

Brands taken together in the second roll of market analysis:

a) **Volkswagen and Ford, between 1990 and 1995**. Between 1990 and 1995 there was Autolatina, a new structure where Volkswagen (51%) and Ford (49%) unified their operations in Brazil, keeping their brands and retailers independent, but exchanging autorparts and knowledge;
b) **Peugeot and Citroen, for the entire dataset.** Both brands are one firm, as the later was taken over by the former in the 70s. PSA (Peugeot and Citroen) started a joint production in Brazil in 1998, at Porto Real (RJ);
c) **Hyundai and CAOA Hyundai, for the entire dataset**. The Brazilian group CAOA started the manufacturing of **Hyundai** in Brazil in 2007, at Anapolis (GO)[137], where it manufactures the SUVs ix35 and New Tucson. However, since 2012 Hyundai motors have its own plant in Piracicaba (SP), where it manufactures the SUV Creta and the small HB20;

[137] The Brazilian press informed that Hyundai motors does not want to renew its partnership agreement with CAOA, expired since April 2018. Source: https://carros.uol.com.br/noticias/redacao/2018/05/08/separacao-de-hyundai-e-caoa-nao-tem-volta-diz-fonte-como-ficam-as-marcas.htm

d) **Renault and Nissan, for the entire dataset**. The global Renaut-Nissan-Mitsubishi alliance includes sharing product development, input purchasing and partial cross-ownership, while keeping independent product brand and competing among themselves. Globally, Renault owns 43,4% of Nissan and Nissan owns 15% of Renault. Nissan bought 34% of Mitsubishi in 2016. As Mitsubishi entered the alliance between those two brands only in 2016, and the manufacturing of **Mitsubishi** cars in Brazil is under licence to a 100% Brazilian industrial group (**MMC/HPE**), we consider this as an independent competitor in Brazil. Nissan and Renault started a joint production in Brazil in 2001, at Sao Jose dos Pinhais (PR), being the first in the world to produce jointly Renault and Nissan vehicles. In 2014 Nissan started a solely production in Rezende (RJ), while still sharing the manufacturing plant with Renault in Sao Jose dos Pinhais as well;

e) **Mitsubishi and Suzuki, for the entire dataset**. In 1995 the Brazilian industrial group **MMC** started the production, under licence, of **Mitsubishi** light commercials in Manaus, initially as SKD. A new plant in Catalao (GO) was inaugurated in 1998, initially producing a light commercial vehicle with only around 50% domestic inputs. In 2001 a new version, totally developed in Brazil, lead to the creation of another company – **HPE**, in order to respect the contractual terms with Mitsubishi. Since 2013 the MMC/HPE group also manufactures **Suzuki** vehicles (producing the model Jimny between 2013 and June 2015 at Itumbiara (GO), and from 2015 at Catalao (GO), in the same factory that produces Mitsubishis). Furthermore, data from Anfavea is aggregated with the two brands, under the name of the manufacturer MMC/HPE, while data from Abeifa are solely for Suzukis manufactured between 2015 and 2018[138].

Special remarks:

i. In August 2014 Cheery inaugurated its plant in Jacarei (SP). In 2017 Caoa bought 50.7% of Chery Brasil, where it manufactures the Cherry QQ, Cellar, Arrizo, Tiggo 2, 5 and 7. The plant is the first of a Chinese brand in Brazil and

[138] Suzuki and Cherry are automakers producing in Brazil but represented by Abeifa, instead of Anfavea.

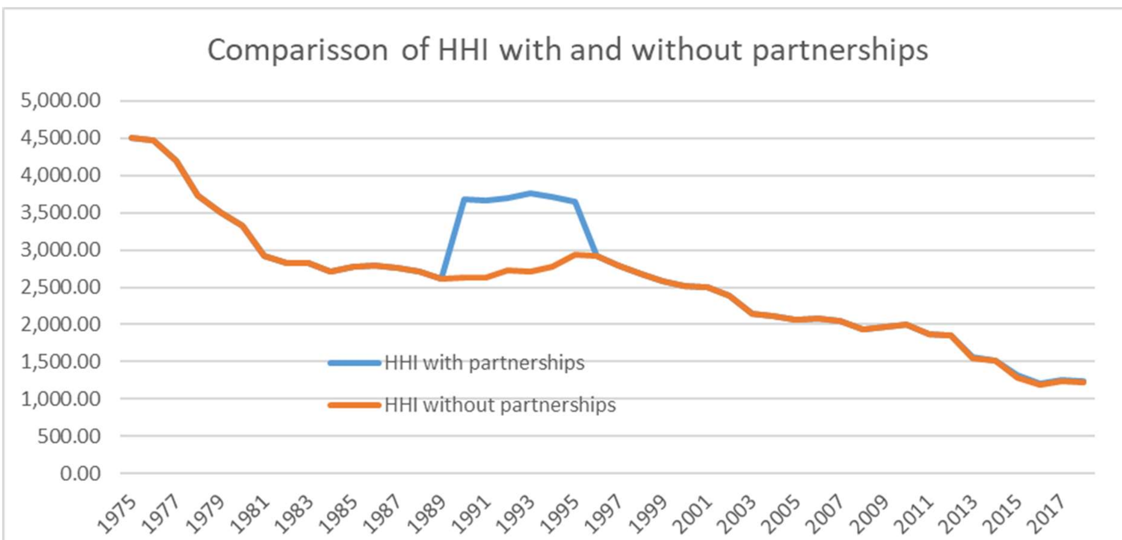
has a production capacity currently set at 50 thousand vehicles per year, but potentially scalable to 150 thousand[139];

ii. Volkswagen owns Audi, but they do not share suppliers and industrial and management facilities in Brazil;

iii. We also do not take into consideration partnerships for product development on global stage, such as the one by Renault and Mercedes.

The results from comparing market concentration indexes with and without these partnerships show only a substantial difference between 1989 and 1996, as shown in graph 9.

Graph 9 – HHI with and without partnerships



[139] The Brazilian press also informs that the CAOA group plans to manufacture some Cherry models at the plant in Anapolis(GO) where it currently manufactures Hiundays. https://carros.uol.com.br/colunas/alta-roda/2018/04/04/caoa-chery-e-so-o-comeco-plano-e-fazer-marca-chinesa-virar-apenas-caoa.htm

Results (source-tables are in the annex):

Table 14 summarizes the evolution of data regarding market-power measures, production, exchange rates, scale, import penetration and real (constant) prices. Data availability constraints allow us to use only a limited time-span, varying according to the chosen indicator. For the purposes of our analysis we did not need to use the data taking into consideration the partnerships among automakers[140]. Regarding prices, we will use data resulting from the quotient between total turnover from sales of domestically manufactured cars and light commercials and total units produced. As explained in our subsection 1, this measure is relatively consistent with other data, although more conservative (in the sense that other data sources point to a steeper decline real in prices). As the series ends in 2017, we estimated a value for 2018 based on the vehicle price inflation measured by IPCA for the year 2018.

[140] The main use of the HHI information (the measure most affected by partnerships, is to compare it with constant average prices. As these prices are only available from 1996 and partnerships only affected HHI up to 1996, there would be no intersection among these two data.

Table 14 - Concentration indexes, scale, prices, and imports of cars

Concentration indexes and scale - Production of cars and lights commercials in Brazil													
Year	Market-share of the leader	Leader	C4	HHI	Number of brands*	Total production (units)	Average production per brand	Average real (constant) car price	Real car price variation	Real effective exchang e rate index	Import penetration coefficient	Change in exchange rate index**	Change in import penetration
1975	61,38%	VW	99,89%	4.509,05	4	818.816	204.704				0,00%		
1976	61,32%	VW	99,83%	4.466,72	5	863.710	172.742				0,00%		
1977	60,47%	VW	99,65%	4.205,14	5	780.928	156.186				0,00%		
1978	55,08%	VW	99,61%	3.736,91	5	941.496	188.299				0,00%		
1979	52,38%	VW	99,59%	3.510,42	5	1.003.578	200.716				0,00%		
1980	49,61%	VW	99,58%	3.323,37	5	1.036.537	207.307			80,89	0,00%		
1981	42,95%	VW	99,41%	2.922,40	5	687.510	137.502			94,06	0,00%	16,27%	
1982	40,48%	VW	99,66%	2.821,33	5	800.764	160.153			101,95	0,00%	8,40%	
1983	40,01%	VW	99,71%	2.815,99	5	853.096	170.619			78,20	0,00%	-23,29%	
1984	37,48%	VW	99,59%	2.715,13	5	807.604	161.521			69,75	0,00%	-10,82%	
1985	38,79%	VW	99,71%	2.769,94	5	892.006	178.401			67,46	0,00%	-3,28%	
1986	38,91%	VW	99,64%	2.784,95	5	957.720	191.544			64,38	0,00%	-4,56%	
1987	37,27%	VW	99,55%	2.758,48	5	829.578	165.916			66,83	0,00%	3,80%	
1988	37,07%	VW	99,49%	2.708,43	5	976.597	195.319			66,16	0,00%	-0,99%	
1989	33,81%	VW	99,46%	2.614,33	5	933.369	186.674			88,63	0,00%	33,96%	
1990	33,23%	VW	99,40%	2.622,41	5	844.563	168.913			109,91	0,02%	24,00%	
1991	32,50%	VW	99,24%	2.625,02	5	884.166	176.833			92,40	2,42%	-15,93%	
1992	33,89%	VW	99,70%	2.723,72	5	1.015.879	203.176			81,29	2,69%	-12,02%	10,88%
1993	34,12%	VW	99,80%	2.707,66	5	1.324.228	264.846			85,48	5,33%	5,16%	98,35%
1994	33,24%	VW	99,75%	2.781,38	5	1.499.817	299.963			89,07	11,63%	4,19%	118,24%
1995	37,90%	VW	99,76%	2.931,01	5	1.536.866	307.373			97,45	20,04%	9,42%	72,27%
1996	35,40%	VW	99,82%	2.928,08	5	1.738.273	347.655	45.661,62		102,82	11,84%	5,51%	-40,94%
1997	32,36%	VW	99,77%	2.784,40	6	1.984.403	330.734	45.898,36	0,52%	105,48	14,33%	2,59%	21,04%
1998	31,95%	VW	98,56%	2.675,31	7	1.497.409	213.916	53.608,15	16,80%	102,54	21,26%	-2,79%	48,43%
1999	31,20%	Fiat	94,40%	2.587,56	9	1.281.463	142.385	56.981,91	6,29%	68,18	13,88%	-33,51%	-34,73%
2000	30,86%	VW	92,49%	2.520,34	9	1.590.716	176.746	56.292,05	-1,21%	73,54	11,21%	7,85%	-19,26%
2001	30,21%	VW	91,53%	2.501,43	10	1.714.893	171.489	55.051,09	-2,20%	61,41	10,59%	-16,49%	-5,48%
2002	30,44%	GM	90,77%	2.380,95	11	1.698.848	154.441	58.490,65	6,25%	58,54	7,27%	-4,67%	-31,39%
2003	29,73%	GM	88,01%	2.143,07	11	1.720.800	156.436	68.667,12	17,40%	55,32	5,09%	-5,50%	-29,96%
2004	29,65%	VW	87,22%	2.115,78	11	2.180.206	198.201	69.927,20	1,84%	58,09	3,49%	5,00%	-31,34%
2005	29,18%	VW	86,68%	2.057,46	11	2.376.296	216.027	68.458,81	-2,10%	70,94	4,78%	22,12%	36,70%
2006	29,63%	VW	86,76%	2.076,98	11	2.470.613	224.601	65.580,04	-4,21%	79,16	6,89%	11,59%	44,15%
2007	28,43%	VW	84,83%	2.041,65	12	2.803.051	233.588	60.705,41	-7,43%	85,08	10,99%	7,48%	59,54%
2008	28,28%	VW	82,27%	1.941,83	12	3.002.091	250.174	60.836,38	0,22%	88,89	13,02%	4,47%	18,55%
2009	28,38%	VW	83,22%	1.961,94	12	3.022.183	251.849	55.200,49	-9,26%	88,11	15,39%	-0,87%	18,15%
2010	31,34%	VW	82,06%	1.995,96	11	3.404.663	309.515	54.852,10	-0,63%	100,00	18,32%	13,49%	19,04%
2011	26,28%	VW	80,19%	1.869,98	11	3.152.355	286.578	53.553,09	-2,37%	103,50	24,48%	3,50%	33,66%
2012	26,23%	VW	79,23%	1.857,10	11	3.248.601	295.327	51.933,68	-3,02%	93,16	21,64%	-9,99%	-11,60%
2013	21,79%	VW	72,46%	1.550,94	12	3.494.014	291.168	52.813,41	1,69%	87,91	19,19%	-5,64%	-11,34%
2014	22,60%	Fiat	70,32%	1.506,91	13	2.987.817	229.832	49.423,02	-6,42%	87,08	18,67%	-0,94%	-2,68%
2015	20,66%	Fiat	63,73%	1.295,94	15	2.349.390	156.626	51.134,37	3,46%	73,40	17,40%	-15,71%	-6,84%
2016	17,95%	Fiat	59,39%	1.198,65	17	2.096.528	123.325	55.797,93	9,12%	78,29	14,43%	6,66%	-17,09%
2017	18,76%	Fiat	61,69%	1.247,14	17	2.633.699	154.923	54.339,93	-2,61%	85,84	11,28%	9,64%	-21,77%
2018	18,09%	Fiat	61,43%	1.226,86	17	2.748.358	161.668	54.856,16	0,95%	79,05	12,54%	-7,91%	11,09%

*Peugeot-Citroen are considered as one brand. All other brands considered independently of partnserships or plant ownsership.

** A higher index means a more appreciated currency

Sources:

Market-shares and concentration indexes calculated by the author, with raw data from Anuario Anfavea 2019 and Abeifa website

Number of brands calculated by the author

Total production calculated by the author, with data from Anuario Anfavea 2019 and Abeifa website

Average production per brand calculated by the author, with data from Anuario Anfavea and Abeifa website

Constant prices of new cars and annual real variation calculated by the author, with data for car prices and overall inflation (IPCA) from SIDRA (www.ibge.gov.br)

Real effective exchange rate index from the WDI (World Bank) and the IMF - International Financial Statistics. Annualized data based on period average.

Import penetration coefficient calculate by the author, with data from Anuario Anfavea 2019 and Abeifa website. Total annual numbers.

Average real car prices calculated dividing total sales of manufactured cars and light commercials by the total number of cars and light commercials produced.

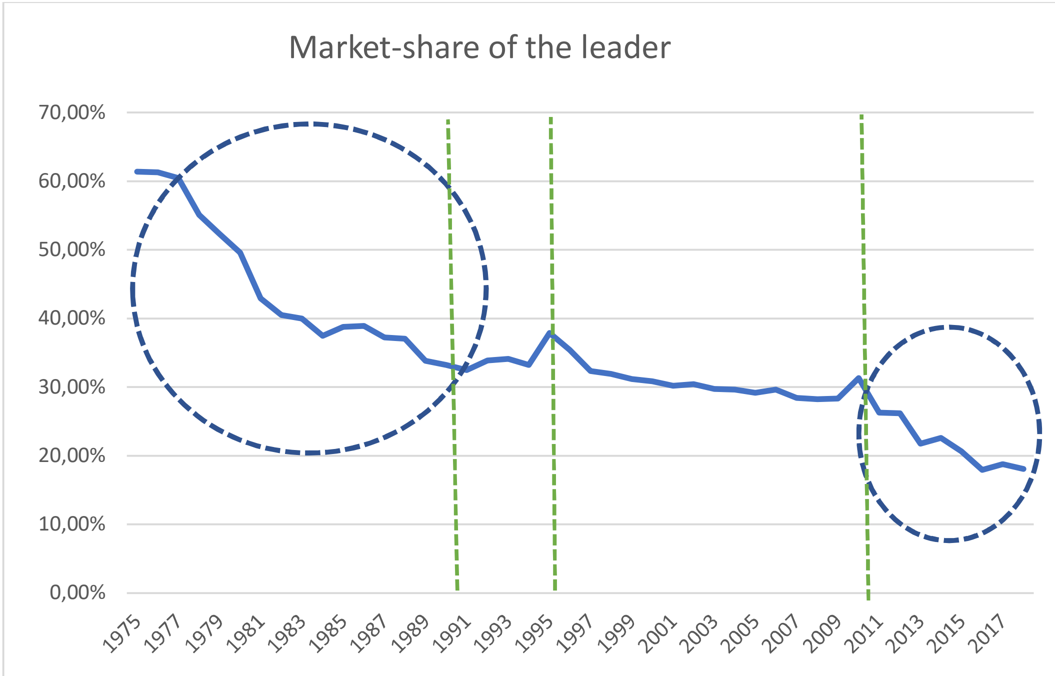
Sources: PIA/IBGE and Anfavea. Obs: Prices for 2018 resulting from the explained calculation plus IPCA inflation in 2018 for vehicles: 0,95%

The market-share of the leader has been decreasing since 1975, even during the period with only 5 brands producing cars and light commercials (graph 10). It is important to note that our market concentration indicators are based on production. Therefore, they do not include imports. This was in line with the decreasing HHI (graph 10). Both indicators indicate the existence of competition, even in a very concentrated domestic market virtually insulated from import competition until the early 90s. We do not have real car price data for that period but given the closeness of the market and the absence of any news of price war, there is indication that the car-prices increased relatively paripassu to the overall price index, and thus such competition seems to have been mainly based on product differentiation.

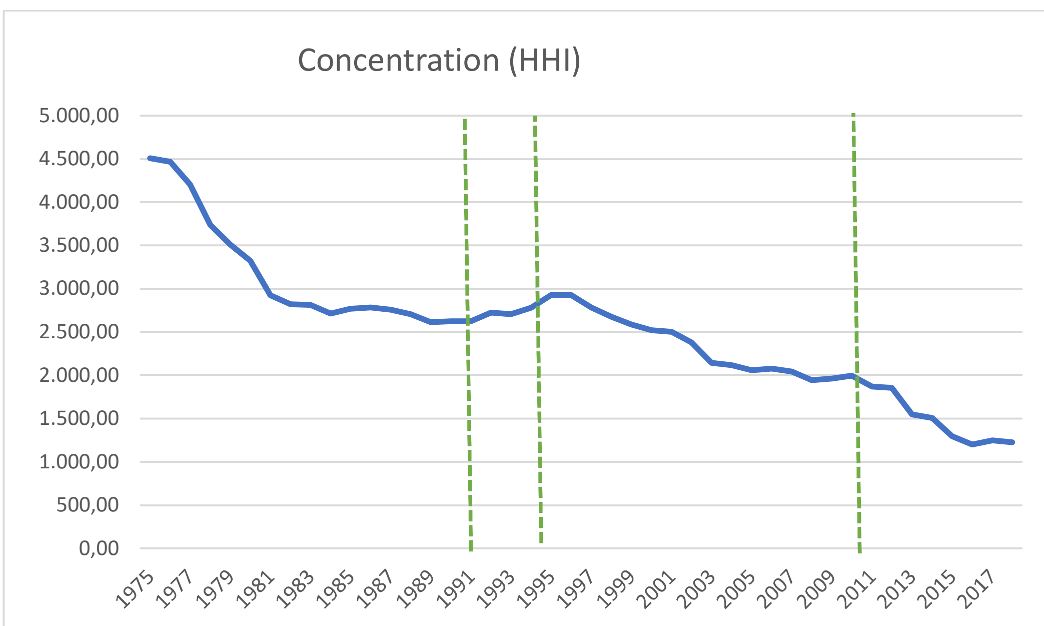
The first vertical line refers to 1991, the year were a combination of tariff and non-tariff barriers reduction effectively exposed the domestic market to foreign competition[141].The second green line marks the start of the automotive policy of 1995-1997 (and its tariff increases and investment attractions). The third line marks the start of Inovar-Auto. The circles highlight periods of intense change.

[141] As explained in the previous subsection, the lift of import prohibition was in 1990, but tariffs were reduced only in 1991, and although imports initiated in 1990, they were very small, until they started to surge in 1991, although still in relatively small numbers.

Graph 10 – Market-share of the leader

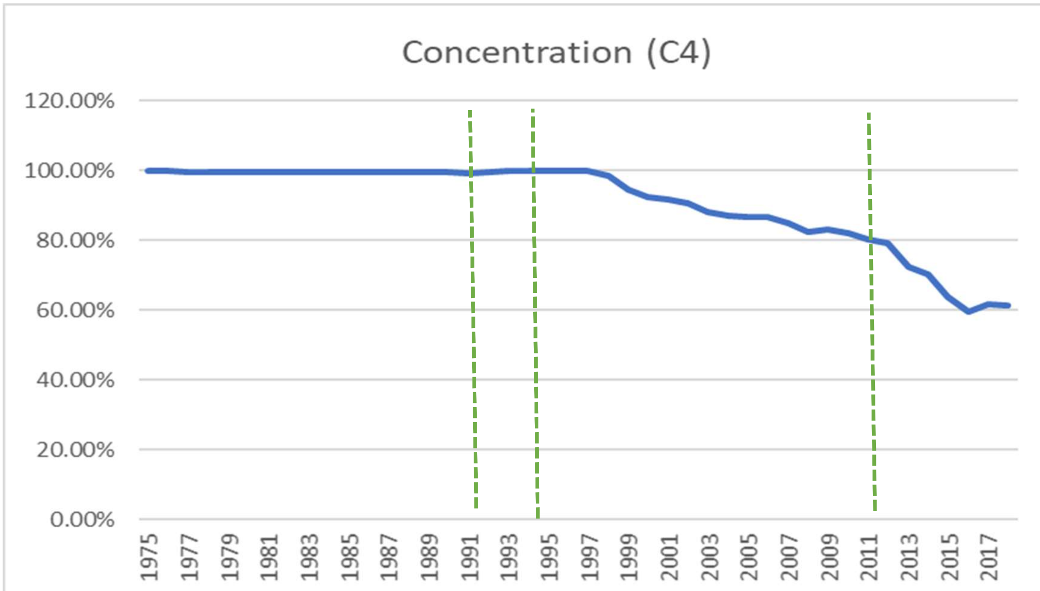


Graph 11 - HHI



Concentration indexes (graphs 10, 11 and 12) only decreased when the new players started to arrive, seeking to heap part of the market growth, and following government incentives put in place in the 90s.

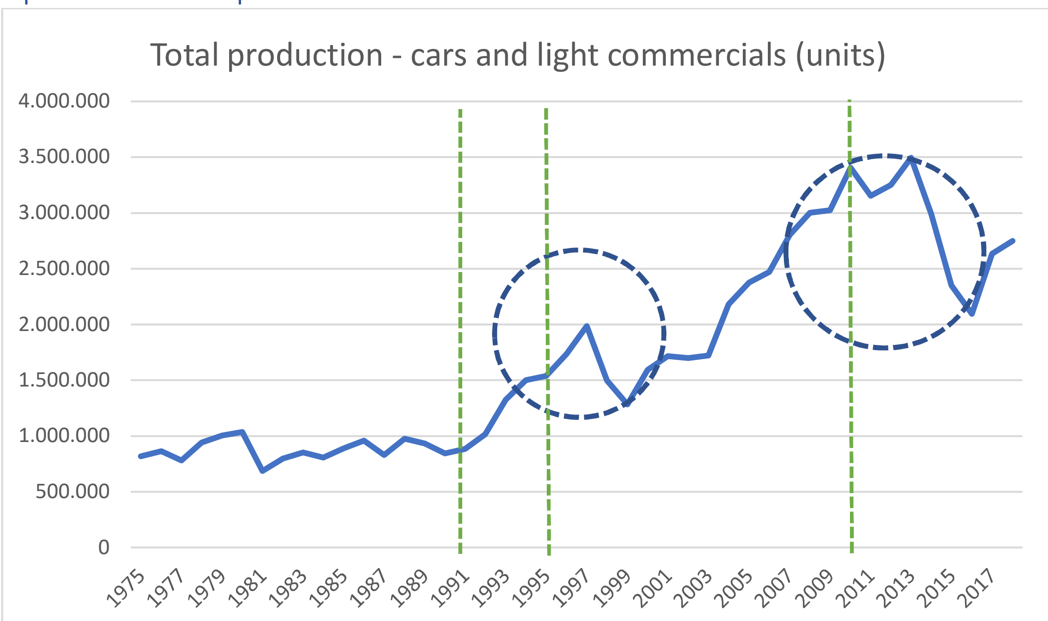
Graph 12 – C4



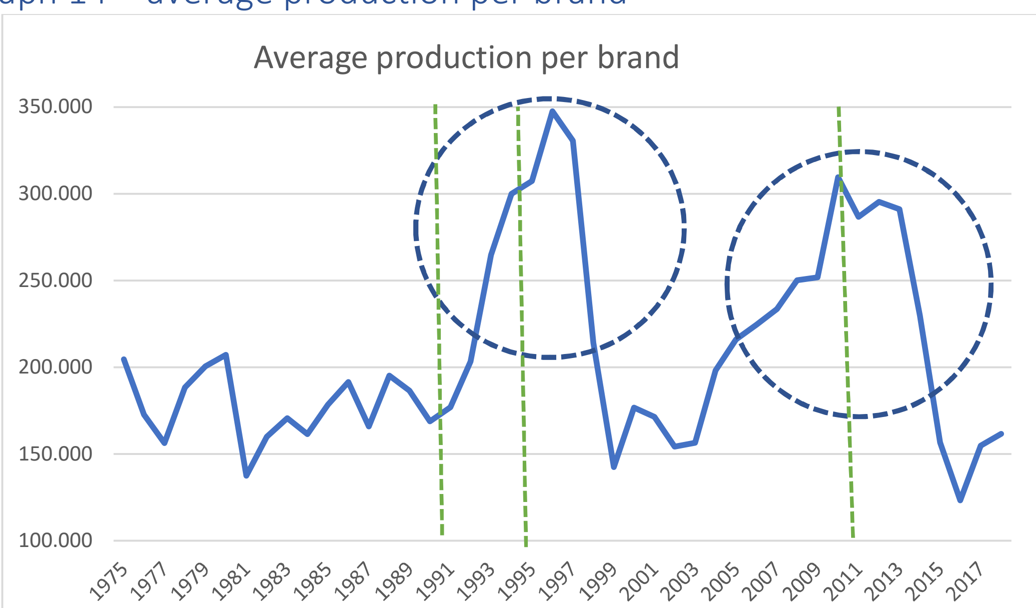
Total production relatively stagnated until 1991, with a bottom in 1981 (graph 13), as well average production per brand (graph 14), given that there was no new player until the late 90s. Following the trade openness of early 90s and the inflation control of 1994, total production started to increase. Average production per brand reaches a peak in 1996, signalling that the domestic producers were enjoying a buoyant market just before the arrival of the new players. The number of brands increase sharply, and concentration decreases as from 1997 to 1999 four new automakers started producing cars in Brazil, and another one (Toyota) setup a plant for mass production of cars for the first time. Average production per brand went down sharply, as a combined result of more players and another economic crisis that reduced total production from 1997 to 1999.

As depicted in graph 13, a production boom occurred following the trade liberalization (1990-1993) and the monetary stabilization of 1994, but the Asian crisis and the subsequent increase in interest rates lead to a sharp decline in production after 1997. The domestic market rebounded from 1999, following the devaluation of the domestic currency, but it took more 4 years for the growing total production lead to an increase in the average production per brand, as new players started production in 2001 and 2002.

Graph 13 – total production



Graph 14 – average production per brand

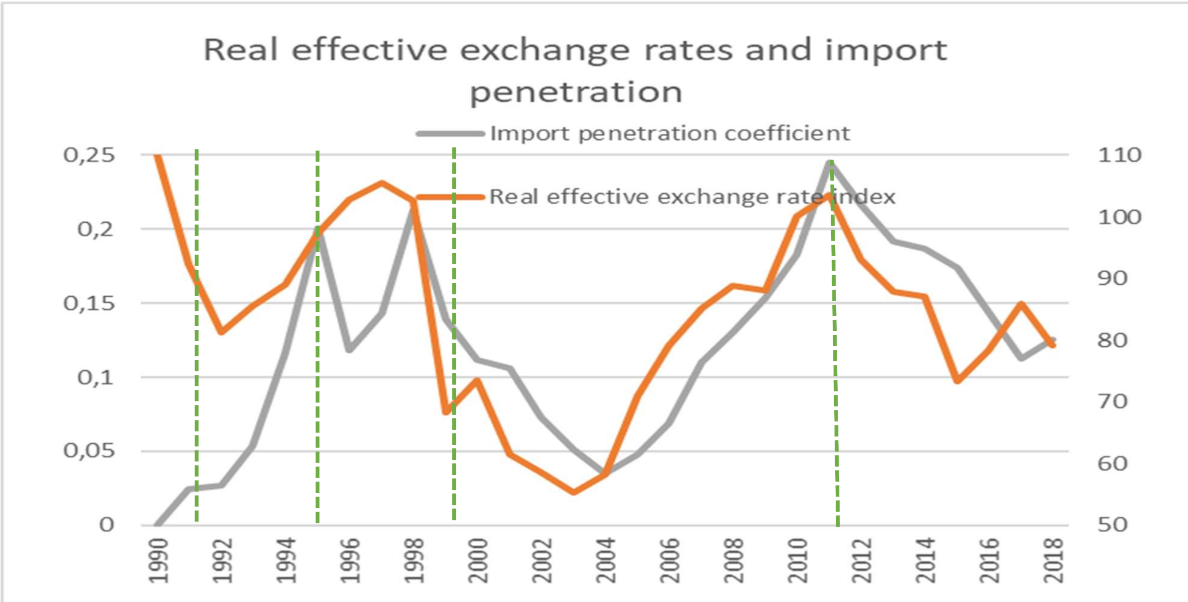


From 2003 the domestic market started a full recovery and both total production and average production per brand increased strongly. Concentration measures kept falling, as well real car prices. The domestic market was very strong in 2011, even with an appreciated currency. Imports were increasingly taking market-share, and the government put in place another automotive policy (Inovar-Auto) to both increase protection against imports (thus counteracting the valuation of the currency) and to attract new producers to the market. It is interesting to note that the increase in total production before the setup of Inovar Auto indicates that, as happened in the 90s, new players would probably be already interested in the domestic market. Following the new government policy new players arrived (although, as discussed in chapter 4, some investment decisions were probably taken before, and thus independently from, the government policy).

Again, as happened in the 90s, the start of production of new players coincided with another economic crisis (from 2013) and thus average production per brand and total production fall sharply between 2013 and 2016 (graph 14).

As noted in the previous subsection, the real effective exchange rate seems to be very correlated with the import penetration: an increase in the value of the domestic currency matches an increase in the market-share of imported cars and light commercials in the domestic Brazilian market (graph 15). Moreover, it seems that the movements in the exchange rate precedes the movements in import penetration. The differences seen between 1990 and 1998 can be attributed to the process of trade liberalization and the changes in import tariffs. After 1999, when import tariffs were stable at 35%, exchange rate movements seem to “granger-cause” import penetration.

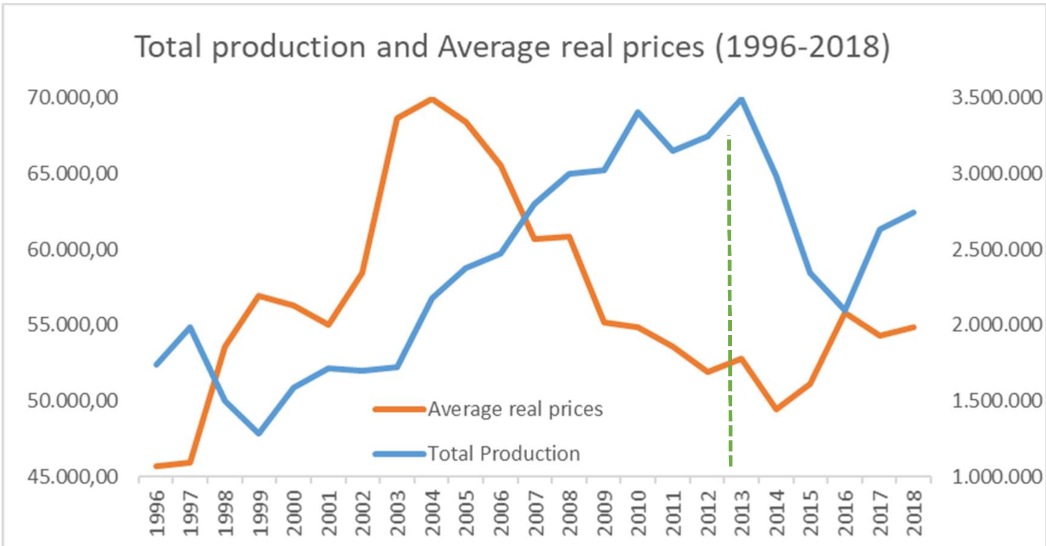
Graph 15 – Real effective exchange rates and import penetration



The dotted lines on graph 15 shows periods of strong import tariff changes: after the trade liberalization of late 1980s/early 1990s, import tariffs fell from 50% to 20% in September 1994, as part of the inflation control efforts. Following the successful monetary stabilization program (Plano Real) and the subsequent exchange rate appreciation of the Real, a hike in imports and a subsequent balance of payments problem (aggravated by the financial outflows caused by the Mexican crisis) lead to an increase in the import tariffs to 70% in March 1995. This was decreased year by year until 1999, when it reached the 35%. In late 2011 the IPI rate for imported cars was increased, thus acting similar to an increase in the Import tariff.

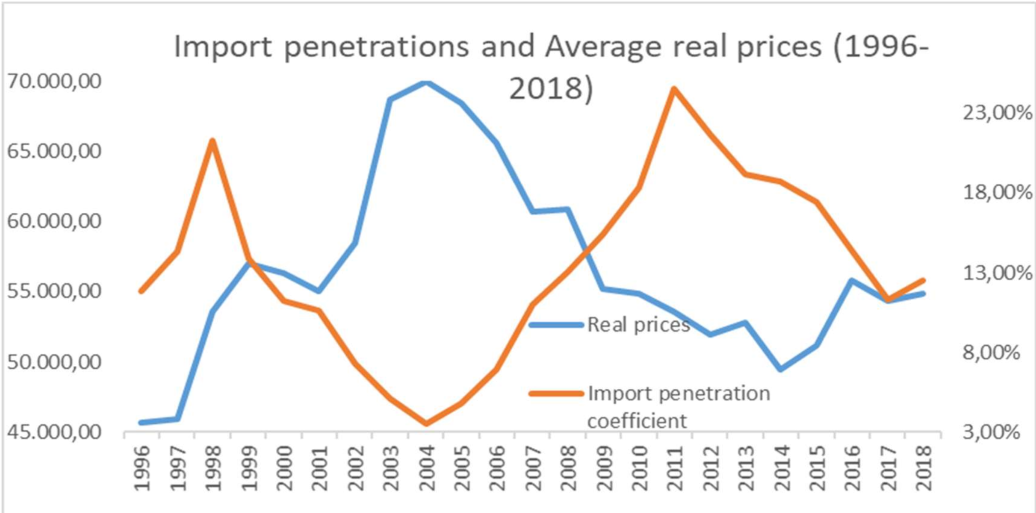
The increase in total production can be seen as an increase in external economies of scale, independently of the behaviour of average scale per plant. Graph 15 suggest that the growth in total production may have had an impact on prices only in the long term: we saw a growing production (external economies of scale) between 1999 and 2011 but only after 2004 a real price decline. Alternatively, we could interpret it as an evidence that total production had no correlation with real price movements, thus corroborating that other factors, such as the exchange rate (foreign competition) or concentration indexes (domestic competition) may explain prices. The potential lagged effect of external economies of scale and prices makes sense from the theoretical point of view, but it is impossible from this data to make any definitive claim on this.

Graph 16 – Total production and average real prices – 1996-2018



Graph 17 suggests that after 1999, more import penetration do reduce domestic prices, in the same period, but this relationship is not very clear as well. Other factors play a role and the resulting effect cannot be analysed from a single explanatory variable. The period between 2015 and 2018 may have been the result of the economic crisis.

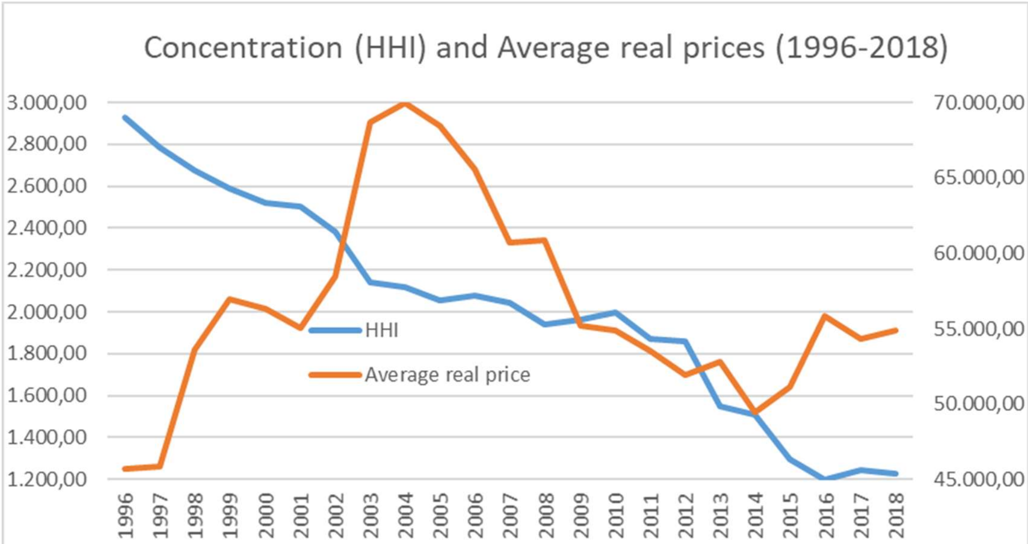
Graph 17 – Import penetration and average real prices



Graph 18 shows a potential effect from decreases in concentration (HHI) to decreases in real prices, but only after 2004. This is a result compatible with the hypothesis of growing domestic competition affecting domestic prices after the automakers that arrived in Brazil in the late 90's and early 2000's reached enough scale of production to start affecting domestic prices around 2004[142]. Again, this effect is competing with the effects from exchange rate variations and total production. A multivariate inferential analysis would be needed to provide further understanding on the drivers of domestic prices. Meanwhile, some correlation coefficients can also shed more light on some of the relationships described.

[142] Honda, for example, one of the new automakers arriving in the 90s, produced only 837 cars in 1997, but 56,544 in 2004. The total number of cars and light commercials produced by the so-called "newcomers" in 1997 represented only 0,23% of total domestic production. In 1999 its was already 5,6%, and in 2004 12,78%.

Graph 18 – HHI and average real prices

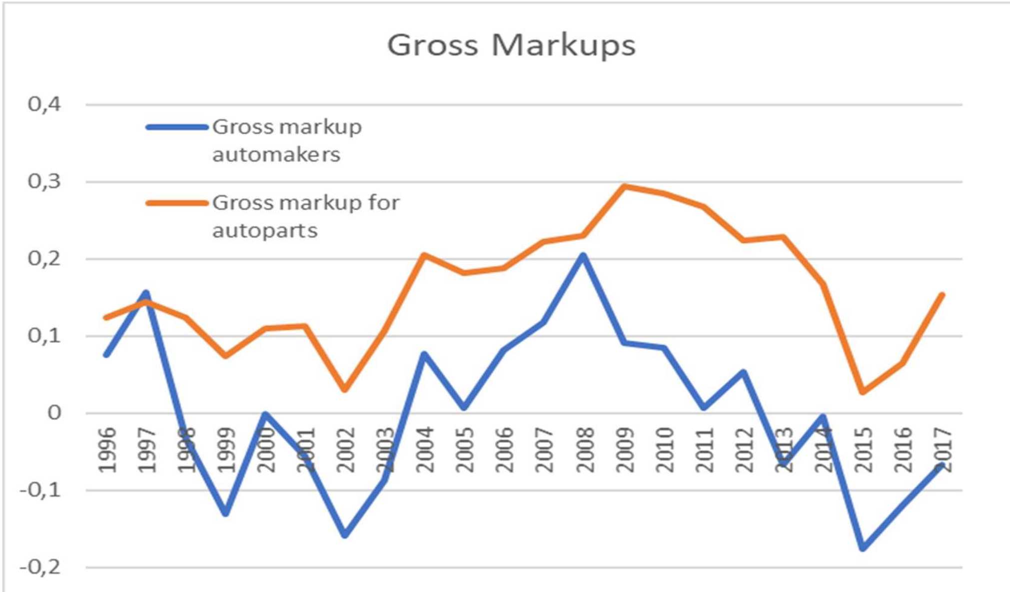


The last piece of data in this subsection is the evolution of markups for automakers and for autopart producers in Brazil, from 1996 to 2018. The definition of markup we use is the following:

$$\frac{(Total\ Gross\ Revenue\ of\ Industrial\ Goods\ (R\$) - Total\ Costs\ and\ Expenses(R\$))}{Total\ Costs\ and\ Expenses(R\$)}$$

Data comes from PIA-Empresa/IBGE, tables 1998, 1999, 1847, and 1845, and are also used as data in our subsection VI.

Graph 19 – Gross markups



Graph 19 thus shows that markup levels for automakers are, on average, smaller than those for autoparts. This is apparently contradictory to the results from our interviews, that exposed a more difficult situation for small tier 3 and 4 autopart producers. We therefore can see that there is potentially very high heterogeneity within the autopart subsector. Moreover, it can be seen that firms increased markups up to the financial crisis of 2009, when the profitability fell sharply, until the bottom line of the Brazilian crisis of 2015. Inovar-Auto seems to have not been capable of reverting this downward trend. Finally, automakers do presented periods of negative markups, both between 1998-2003 (post Asian crisis and up to political uncertainties in Brazil, a period marked by very high interest rates) and between 2013 and 2017.

We calculate the Pearson`s correlation for the sample (r). Our data seems to show a linear relationship, thus there is no indication for the need of a different correlation statistics.

However, we need to make an important note on what kind of variables can be used here and what is the effect of time trends. As widely known, the Pearson coefficient is calculated as a deviation from the mean, and thus will tend to show a positive correlation when two series are increasing, even if they do it in an inverse pattern (thus, in fact, showing negative correlation). To avoid this problem, we could detrend the series before we calculate the correlation coefficient. The same "correction" would be obtained when we assess the relationship between price changes instead of simply prices, for example. The trick is that sometimes we just want to see if both series increase or decrease together, without any need for them to do so in a perfect matching way. Therefore, if this is the case, no detrend is needed and we can estimate the correlation between two level variables, for example. Thus, we need to carefully examine each variable under analysis, before proceeding with the correlation.

The real exchange rate index and the import penetration coefficients are level variables with no time trend. Therefore, they do not need to be detrended.

Cars at constant prices (index) and total production are level variables. Although it is expected that production grows and real prices decreases in time, this process can take many years and can be reversed. Therefore, it is reasonable to assume that they do not have a clear trend. Thus, we assume there is no strong or clear time trend in the variables used for the correlation analysis.

In the first comparison, between real exchange rate index and import penetration coefficient, using annual data from 1991[143] to 2018, we are interested in knowing if imports are affected by the level of the exchange rate, as this is a factor affecting the costs of imported goods. Thus, we are looking at its inflation-adjusted value, as if it was a tariff. Annualized data minimizes problems related to timing of exchange rate movements and its impact on prices. Exchange rate is annualized using period average. Import penetration is based on total annual numbers.

Real exchange rate index X Import penetration coefficient				0,56669

The positive and relatively high correlation (0,57) indicate that a more appreciated domestic currency is related to higher import penetration levels, as expected. Although the correlation cannot provide any assessment of the causality, the potential

[143] Despite we have data for 1990, we started with 1991 because in 1990 imports were still incipient because of the trade liberalization was in its starting process. Therefore, using 1990 would bias the correlation result.

explanation for the relation between these two variables is straightforward: a valuation of the domestic currency makes the price of imports cheaper.

The second comparison is between Real car price and the exchange rate index, from 1996 to 2018.

Real exchange rate index X Real car price				-0,6576047

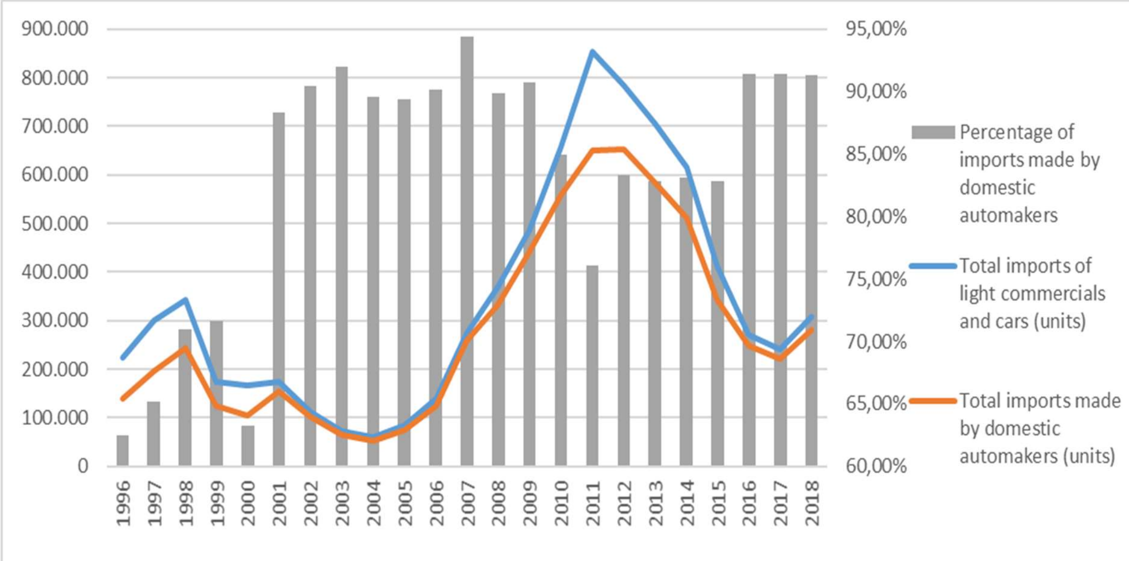
As expected, we had a strong negative correlation. The value of -0,66 indicates that real car prices move in the opposite direction of exchange rates: a depreciation of the domestic currency is associated with an increase in car prices in the domestic market. Again, this is in line with the argument that a weaker domestic currency acts as a tariff against imports and that this reduces import competition and thus allow for higher domestic prices.

If we compare directly the import penetration level with the real car price level, from 1996 to 2018, we get:

Import penetration X Real car price				-0,70863643

Thus, we confirm that less import competition is associated with higher domestic prices, and vice-versa. But how the imports made by automakers with production lines in Brazil could affect our results` insights? The following table brings the evolution of car imports made by domestic producers as a % of total car imports:

Graph 20 – Relative importance of imports by domestic automakers



The percentage of imports made by domestic automakers departed from around 65% between 1996 and 2000 (when imports were in any case relatively low) to around 90% between 2001 and 2009. The peak was in 2007, when 94% of all cars and light commercials imported in Brazil was done by automakers with domestic production. These figures were reduced to the new bottom of 76% in 2011, but quickly increased to an average of 83% between 2012 and 2015 and to around 91% from 2016 to 2018.

We can then see from the graph that the surge in imports verified from 2004 (with a peak in 2011) was increasingly accompanied by an increase in competition from imported vehicles from producers that had no plant in Brazil: these were mainly the Chinese producers. The increase in market-share of imported Chinese vehicles can be seen as a worldwide phenomenon. What is clear, in the Brazilian case, is that Inovar-Auto policy - the added 35% tax on imports from producers without domestic production, set up in 2011/2012 - do seems to have had an impact in reducing imports from non-domestic producers. This effect is quite difficult to be disentangled from the overall fall in imports that followed the 2011 peak, but it is visible in the graph and is consistent with the evidence gathered in our interviews.

If we take graph 20 into consideration, it seems that the relative importance of imports made by non-domestic producers did not change the previous result of more import penetration leading to lower prices. In this sense, it could be argued that imports made by domestic producers can indeed add to the competition pressure in the domestic market. This could be the case if we assume that (i) subsidiaries exporting to Brazil are in fact competing with the same companies` Brazilian subsidiaries or (ii) when the exchange rate is overvalued, automakers choose to bring other models from subsidiaries outside Brazil.

Now, apart from foreign competition, are domestic competition and scale also associated with changes in domestic prices? Comparing the level variables cars at constant prices with the HHI measure of concentration (a proxy for domestic competition), from 1996 to 2018, we get:

Cars at constant prices X HHI	-0,02746458

There is a very small negative correlation between these two series of variables, suggesting no clear relationship. Given the low value obtained, other variables are probably contributing to this result, as demonstrated in the other correlation coefficients.

Now, let's see the relationships between real car prices and scale of production. First, total production (a proxy for external economies of scale), from 1996 to 2018. In this case we got a small negative association (-0.10). The negative signal is as expected, as it seems external economies of scale are affecting Brazilian automakers. Then, using average scale per firm, in the same years, we got a strong negative one, again, as expected. This means average scale per firm is associated with the reduction in real car prices.

Cars at constant prices X total production	-0,10737769
Cars at constant prices X average production per firm	-0,41154911

Conclusions from this section

Different measures generated different results of real prices` evolution for cars in Brazil from 1989 to 2018. The insight is that real prices went down during the trade liberalization process, and that they probably went up from 1997 to 2004 and down again from 2005 to 2014.

It seems that after the trade liberalization of early 90s, exchange rates played an important role in the total import barrier against imports, and the import tariff was a complement for that. These cost barriers to imports probably had an impact on domestic prices, together with an impact from the increasing domestic competition brought by newcomers, attracted by different industrial policies during the last 30 years. And import competition apparently had a stronger effect on domestic prices than domestic competition, although it is not possible to disentangle these effects based solely on univariate analysis. In section 6.6 we indeed develop some multivariate analysis but were restricted by the low number of annual observations.

Total production rose during the period, as also the number of domestic producers. The average scale per producer, a result from these two previous measures, showed an oscillated behaviour. In the qualitative chapter there was the argument that although new entrants may have increased domestic competition, these new entrants also contributed to reduce average scale vis a vis what would be observed without them. However, our correlation results show that average scale per firm seems to have had an important impact on price reduction. As said before, only a multivariate analysis could try to disentangle these effects.

6.4 – COMPARISON OF COST STRUCTURES AND SENSITIVITY ANALYSIS

In this subsection we estimate a representative cost structure for autopart firms, using real average data, and conduct simulations to assess the relative importance and impact of changes in the business environment, scale, and protection levels. The comparison is among the average cost structure for automakers in Brazil in 2017 versus the average cost structure of other manufacturing sectors (agricultural machines, motorcycle, aeronautical) in Brazil in 2017.

The data collected from PIA/IBGE and is in Appendix III.

As can be seen on table 15, the value added of vehicle manufacturers (here including not only cars and light commercials, but also chassis, buses and trucks) is relatively smaller than the average value added for total manufacturing. Autoparts, tractors, motorcycles and aircrafts, for example, all have a higher proportion of value added as a percentage of revenues. This suggests that automakers are directly contributing with a relatively small amount to the total value added in the economy, although with a high amount in absolute terms. The potential explanation from the data is because vehicles have a relatively smaller use of labour, an important part of value added.

In terms of costs, raw materials and inputs comprise on average 48% of the total costs incurred in the manufacturing of final goods in the vehicles, chassis and trailers segment. Autopart production has a similar number, with around 45% of its production costs coming from raw materials and inputs. These numbers contrast with the labour costs: they represent only 7.2% of the costs for vehicle manufactures, while 14% of the production costs for autopart producers.

On table 15 we compare the segment of cars and light commercials with other segments of the automotive sector. It can be seen that wages are relatively even less important for automakers than for any other segment, while raw materials and inputs is relatively more important for automakers than for the other segments of the industry.

Autoparts rely relatively more on labour, and slightly less on raw materials and inputs than automakers.

Table 15 – Comparison among sectors (vehicles and parts)

COMPARISON AMONG SECTORS - SELECTED INDICATORS (VEHICLES AND PARTS)				
29-VEHICLES, CHASSIS, TRAILLERS AND AUTOPARTS	29.10-CARS, SUVs AND LIGHT COMMERCIALS	29.20-TRUCKS AND BUSES	29.30-CABINS AND CHASSIS	29.4-AUTOPARTS
GROSS REVENUE AS % OF TOTAL VEHICLES, CHASSIS, TRAILERS AND AUTOPARTS				
100%	53.53%	9.88%	3.63%	32.89%
WAGES AS % OF TOTAL COSTS (INTRASECTOR)				
9.25%	6.33%	8.10%	15.98%	13.71%
RAW MATERIALS AND INPUTS AS % OF TOTAL COSTS (INTRASECTOR)				
46.74%	48.64%	45.21%	43.12%	44.53%
FINANCIAL EXPENSES AS % OF TOTAL COSTS (INTRASECTOR)				
5.00%	5.63%	2.56%	7.32%	4.45%
PROFIT BEFORE TAXES AS % OF GROSS REVENUE FROM SALES AND SERVICES (INTRASECTOR)				
-5.53%	-6.72%	-6.43%	-5.43%	-3.32%
VALUE ADDED AS % OF GROSS REVENUE FROM SALES AND SERVICES (INTRASECTOR)				
12.87%	7.98%	9.32%	19.11%	21.14%
Data source: PIA/IBGE. Calculations by the author				

Table 16 goes even further in the details, analysing the results from different autoparts. Brake systems parts have the lowest value-added and the highest proportion of costs coming from raw materials and inputs. This suggest this subsector is the closest to a situation of just assembling pre-built parts. On the other hand, are engine parts, transmission and gearbox parts, with a relative high amount of value added and a relatively higher participation of wages.

Table 16 – Comparison among subsectors - autoparts

COMPARISON AMONG SECTORS - SELECTED INDICATORS (AUTOPARTS)						
29.4-AUTOPARTS	29.41-ENGINE PARTS	29.42-TRANSMISSIONS AND GEARBOX PARTS	29.43-BREAK SYSTEM PARTS	29.44-DRIVING WHEEL AND BUMPER SYSTEMS PARTS	29.45-ELECTRIC AND ELCTRONIC MATERIAL PARTS, EXCEPT BATTERIES	29.49-OTHER AUTOPARTS
GROSS REVENUE AS % OF TOTAL AUTOPARTS						
100%	16.32%	9.36%	6.25%	10.35%	18.72%	39.00%
WAGES AS % OF TOTAL COSTS (INTRASECTOR)						
13.71%	15.55%	15.58%	11.47%	11.67%	13.74%	13.28%
RAW MATERIALS AND INPUTS AS % OF TOTAL COSTS (INTRASECTOR)						
44.53%	36.20%	42.69%	54.77%	50.83%	38.84%	48.36%
FINANCIAL EXPENSES AS % OF TOTAL COSTS (INTRASECTOR)						
4.45%	5.78%	2.97%	3.01%	4.99%	3.24%	4.92%
PROFIT BEFORE TAXES AS % OF GROSS REVENUE FROM SALES AND SERVICES (INTRASECTOR)						
-3.32%	-4.29%	-3.23%	-5.35%	-1.98%	-4.04%	-2.61%
VALUE ADDED AS % OF GROSS REVENUE FROM SALES AND SERVICES (INTRASECTOR)						
21.14%	26.49%	22.40%	13.56%	16.95%	22.03%	20.49%
Data source: PIA/IBGE. Calculations by the author						

With these data we carry on a sensitivity analysis, to verify how performance and competitiveness could be affected by changes in variables related to: a) trade barriers; b) business environment; c) scale of production; d) specialization and labour productivity.

On table 17 we see that, for cars and light commercials, the total costs potentially affected by trade tariffs are 46.35% of the total gross revenue, while the total costs potentially affected by the business environment are 12,67% of the total gross revenue. These are of course estimates of the direct impact, as the business environment can also affect the purchase process of inputs and industrial services.

For the autopart sector the situation is: the total costs potentially affected by trade tariffs are 42.13% of the total gross revenue, while the total costs potentially affected by the business environment are 11.18% of the total gross revenue. These are, as said before, estimates only of the direct impact, as the business environment can also affect the purchase process of inputs and industrial services.

Table 17 – Costs affected by tariffs and by the business environment

	29.10-CARS, SUVs AND LIGHT COMMERCIALS	29.4-AUTOPARTS
TOTAL GROSS REVENUE FROM SALES AND SERVICES	149,928,958.00	92,114,219.00
TOTAL NET REVENUE (-TAXES AND RETURNED ITEMS + OTHER INCOMES)	131,445,776.00	79,456,549.00
TOTAL COSTS AFFECTED BY TRADE TARIFFS	**69,526,136.00**	**38,840,321.00**
PURCHASES OF RAW MATERIALS AND INPUTS	68,845,458.00	36,738,668.00
PARTS, ACESSORIES AND SMALL TOOLS	137,093.00	1,110,297.00
INDUSTRIAL SERVICES	543,585.00	991,356.00
TOTAL COSTS AFFECTED BY THE BUSINESS ENVIRONMENT	**19,012,843.00**	**10,309,928.00**
FUEL FOR MACHINES	168,158.00	317,876.00
ELETRICITY	497,057.00	1,531,775.00
FREIGHT	3,340,817.00	1,068,195.00
TAXES	769,676.00	532,212.00
INSURANCE	93,027.00	104,027.00
PASSIVE MONETARY VARIATIONS	6,110,526.00	3,014,181.00
FINANCIAL EXPENSES	7,966,234.00	3,669,349.00
WATER AND SEWAGE	67,348.00	72,313.00
TOTAL COSTS AND EXPENSES	141,527,273.00	82,510,239.00
PROFIT BEFORE TAXES		
PROFIT BEFORE TAXES	-10,081,497.00	-3,053,690.00

Given these results, in table 18 we undertake an exercise to simulate the impact of a trade liberalization that reduces tariffs for inputs and autoparts to zero. This would generate a cost reduction of 6% of the total production costs for automakers. This, in terms of final prices, would be a relatively small number.

Table 18 – Scenario 1: trade tariffs to zero

SCENARIO 1 - TRADE TARIFFS REDUCED TO ZERO		
HOW TO CALCULATE		
Initial tariffs for inputs and autoparts:		14%
Assuming complete passtrough from tariffs to prices, tariff reduction would reduce the costs of raw materials, inputs, autoparts, acessories, small tools and industrial services.		
Conversion factor for initial prices of inputs and autoparts without the tariffs (100/(1+14%))/100:		0,88
Cost reduction of inputs and autoparts:		12,28%
CARS, SUVs AND LIGHT COMMERCIALS	AUTOPARTS	
Cost reduction:		
8.538.297,40	**4.769.863,98**	
Cost reduction as % of total costs		
6,03%	**5,78%**	

In table 19 we undertake a similar exercise, but this time regarding an improvement in the business environment. It is not straightforward to calculate cost reductions directly transform from changes in business environment indexes. To avoid such heroic exercise, we opted for calculating the impact of a change in the interest rates. This variable is perhaps the most representative of the business environment, as the most successful countries tend either to have more monetary stability in the long-term (thus, lower interest rates), and also a better institutional environment to issue debt at lower interest rates.

The baseline annual interest rate set by the Brazilian Central Bank was 6.5% on 31 December 2018. This interest rate target felt, gradually, from 14,25% between 2015/2016 to the 6.5% level on early 2018. This directly impacts the costs related to "financial expenses". In our exercise this accounts for 5,63% of the total costs for automakers, and 4,45% for autoparts. If the interest rate is set to zero, financial expenses would go to zero. Therefore, the savings would be almost 6% for automakers. Again, in terms of final prices, would be a relatively small number.

Another cost item potentially directly affected by a better business environment would be freight. Data on the costs to import autoparts, from the 2018 Doing Business Report[144] point to 1.076 US dollars. The same data for New Zealand, the best overall

[144] Documentary and border compliance costs, gathered by the Doing Business Report, 2018, from the World Bank. Available at https://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-

business environment according to the report, points to 447 US dollars, and for the UK or Portugal, both at the best in this particular indicator, the cost is zero. However, there is no comprehensive and internationally comparable data on domestic freight costs using the different transport modes. If we arbitrary assume a potential freight cost reduction of 50%, we would be arriving at another 0.65% to 1.2% reduction in total costs.

Table 19 – Scenario 2 – Interest rates to zero

SCENARIO 2 - INTEREST RATES REDUCED TO ZERO			
	HOW TO CALCULATE		
	Initial financial expenses:		
		CARS, SUVs AND LIGHT COMMERCIALS:	7.966.234,00
		AUTOPARTS:	3.669.349,00
	Assume interest rates go to zero.		
	The result would be financial expenses (interest rates on financing) also beeing zero.		
	CARS, SUVs AND LIGHT COMMERCIALS	AUTOPARTS	
	Cost reduction:		
	7.966.234,00	**3.669.349,00**	
	Cost reduction as % of total costs		
	5,63%	**4,45%**	

Conclusions from this section

The maximum direct cost reductions that would be possible with a zero-import tariff for inputs would be around 6%, for automakers and autopart producers alike. On the other hand, the maximum direct cost reductions that would be possible with a zero interest rates (a proxy for the ceiling in terms of business environment improvement) would be around 5,6% for automakers and 4,5% for autopart producers.

As said before, these cost reductions are only the direct ones. Such changes in tariffs and interest rates would affect the entire supply chain, thus potentially increasing the effect of cost reductions.

Reports/English/DB2018-Full-Report.pdf . According to the Report, for the calculations it is assumed the import of containerized auto parts from the most important trade partner for these goods.

Although we used interest rates as a proxy, there is scope for further improvements in the business environment affecting the cost of freight.

Tariffs and business environment thus seem to have a similar (in value) contribution to total costs.

6.5 – Estimation of changes in Total Factor Productivity for the Brazilian automotive sector from 1996 to 2017.

We now check if and how the productivity of the automotive sector in Brazil evolved, using traditional measures of productivity. Under competition, the productivity behaviour is the main driver for costs, although prices can also be affected by trade barriers and other entry barriers, as seen in the previous subsections.

Initially we will provide an overview of the key concepts necessary to proceed with the analysis. Productivity is a measure of efficiency and relates how well inputs are transformed into outputs. There are different concepts of productivity, but the three most important for the study of economic production are:

- Labour productivity: measures the efficiency of the labour force. The main sources of labour productivity are: a) capital per worker, reflecting that more machinery and tools can increase the efficiency of the worker; b) a better use of the capital available, by the worker, given a better training or cognitive abilities.
- Capital productivity: the efficiency of the stock of capital used in production.
- Total Factor Productivity – TFP: measures how efficiently a firm or an economy uses its inputs to generate its outputs, usually discounting the effect of increases in labour and capital and is a proxy for the technological progress.

However, TFP can be the result of many sources of efficiency, not only technological progress. Among these there are the gains from economies of scale and market-share reallocation, for example.

As summarized by Van Ark (2014), potential sources of TFP thus include a myriad of factors, from where we point the following as examples:

- Economies of scale;
- Network effects;
- Better allocation of resources (via competition, for example);
- Labour and capital quality improvements;
- Better institutions;
- Innovations and adoption of new technologies etc.

Van Ark, Bart (2014). Total factor productivity: Lessons from the past and directions for the future, NBB Working Paper, No. 271, National Bank of Belgium, Brussels. Available at: http://hdl.handle.net/10419/144483

As already discussed in the conceptual chapter, economies of scale relate the reduction of average production costs to the increase in production size. As potential sources of economies of scale we could cite:

- Increasing returns to scale within the firm production function (thus, a source of technical efficiency[145]);
- Spreading of fixed costs;
- More labour specialization and learning;
- More negotiation power for input purchases, including finance.

Increasing returns to scale is a concept slightly different from economies of scale, as the former only implies that output grows more than proportionally to the increase in inputs, given the technical characteristic of the production function of the firm. It is therefore only one of the many potential sources of economies of scale.

[145] Technical efficiency can be viewed as a situation where the producer reaches maximum output with minimum cost.

A better use of installed capacity can also promote economies of scale gains.[146] Besides economies of scale, there are other sources of productivity and thus ways to reduce average costs:

- Technical efficiency not related to scale (maximum output with minimum cost, as already mentioned);
- Allocative efficiency not related to scale[147] (how well inputs are combined to produce an output).

The standard way to estimate the Total Factor Productivity is using a production function to obtain the TFP as a residual, after measuring the effects of capital and labour on production. As it is calculated as a residual, its measurement quality depends on the measurement quality of the other factors that enter the production function. The literature suggests different ways to measure the contribution of capital and labour, and sometimes accounting for other factors as well, that enter the production either independently, or interacting with the original labour or capital measure. For example, the use of a measure of human capital as part of the production function, for the calculations of TFP[148].

The usual production function is a Cobb-Douglas one, and therefore it is necessary to obtain the right share of capital and labour in that economy or sector, to properly set up the function.

The results for the TFP evolution in Brazil were very diverse, because it depends on the time-period reported, on the sectors included, on the type of measurement and data used for the production factors, and on the production function itself. Therefore, it is quite difficult to provide useful accounts of the results from the literature. The main message that is possible to extracted from key studies – for Brazil - is that overall TFP:

[146] Nonetheless, capacity utilization refers to producing at an output below the rated capacity of a given plant, and economies of scale refers to the fact that larger size plants have lower costs.
[147] One way to understand how allocative efficiency operates is to think of a technology that reduce the cost of some input (or bring a new and more productive input) but requires a complementary input. An eventual lack of this complementary input (in quantity or quality) would reduce the allocative efficiency (potentially departing further away from the maximum allocative efficiency point where the marginal rate of technical substitution equals the ratio of input prices).
[148] Taking labour as an example, it can be understood as the result of labour supply (quantity) and human capital (quality). A higher human capital would lead to higher labour productivity.

- Decreased in the 80s;
- Increased after the trade liberalization of early nineties, but at a low rate, as it combined a faster increase in the early nineties with a slower increase – or even a decrease – in the late nineties;
- Increased in the 2000`s at a faster pace, on average;
- Decreased in the 2010`s.

Overall, between the 90`s and the 2010`s it seems that TFP in Brazil also lagged in relative terms with the technological frontier (the United States). The literature suggests that the main contributors to Brazilian economic growth from the 90`s to the 2010`s were factor accumulation, not TFP: both an increase in the labour supply together with an improvement in labour capital (quality of labour, resulting from improvements in education) and capital accumulation. In fact, it is argued that the main drag was the low levels of competition and exit rates within economic sectors[149].

These measures can be misleading because some studies combine the results from extractive industries with manufacturing sectors. Moreover, some studies include in their analyses the agriculture, the services and the industrial sectors all together. This can hide important differences: agriculture TFP increased strongly, at a faster pace than the technological frontier, while manufacturing`s TFP decreased, even in absolute terms in some periods of time[150].

We will provide an account of the evolution of TFP for the automotive sector - isolated from other sectors - thus allowing an analysis with our other quantitative and qualitative results.

In this subsection we do not intend to provide an exhaustive study of the evolution and determinants of the TFP for the Brazilian automotive sector, but only obtain another piece of information, to be contrasted with all other data we have, enhancing our triangulation methodology.

[149] Qian, Araújo and Nucifora (2018). Brazil's Productivity Dynamics. The World Bank.

[150] According to Barbosa Filho, Pessoa, and Veloso (2010), the weak performance of TFP during the 80s is shared mainly with other Latin American countries, suggesting that common characteristics of this region could explain it.

The production function is the following:

$$Yt = \mathrm{At}(Kt)^{\alpha}(\mathrm{L}t)^{1-\alpha}$$

Where Alfa is the share of income from capital in the total income and 1-alfa is the share of labour[151]. K is the stock of physical capital, L is the stock of Labour, A is the Total Factor Productivity, and Y is the total production. Both L and K can be adjusted to incorporate variables that can make them more realistic.

To estimate aggregated TFP using the accounting process we do not need to run any econometric regression, but only to get data for the selected variables and organize them into a specific production function. Following the literature this will be a Cobb-Douglas. We then apply natural logarithms and difference it in relation to time (getting a measure of variation). The transformed Cobb-Douglas production function is then expressed as:

$$\Delta A = \Delta Y - \alpha \Delta K - (1-\alpha)\Delta L$$

The following table brings a list of alternative measures for K, L and Y, usually used in the literature that calculates the TFP for Brazil (if not explicitly stated, the calculations are for the overall economy, not only for the manufacturing sector):

[151] This would be true under the hypothesis that labour marginal productivity equals wage, and capital marginal productivity equals the interest rate, their remuneration.

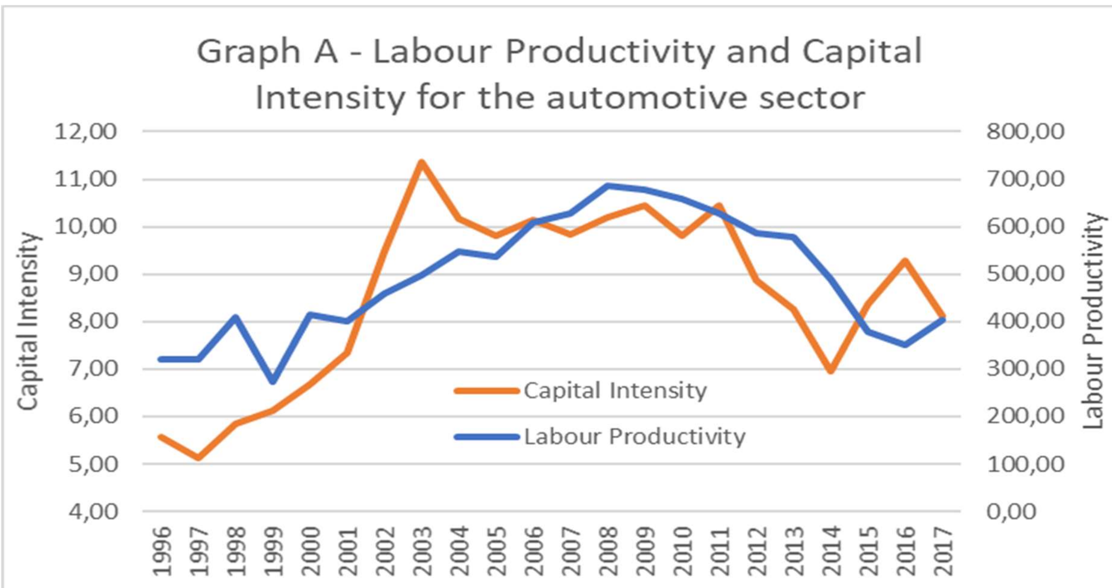
Table 20 – Different measures of Y, K, L and α

Authors and scope considered in this review	Y	K	L	α (capital income over total income)
Barboa Filho, Pessoa, and Veloso (2010): overall economy	GDP at constant prices, from National Accounts at IBGE.	Stock of capital, calculated using the method of investment and depreciation, adjusted by the capacity utilization	Number of hours adjusted by a measure of human capital	0,4
Gazzoli and Messa (2017)[2]: industrial sector (manufacturing and extractive industry)	Gross Revenue	Capital stock, derived by the author following a methodology as in Alves e Silva (2008)	Employed personnel	Data at firm level
Messa (2017): industrial sector (manufacturing and extractive industry)	Value added	Methodology from Alves and Silva (2008)	Average number of workers in the year	Data at firm level
Hidalgo and Mata (2009): industrial sector (manufacturing and extractive industry)	Value of industrial transformation for each firm	Energy consumption	Total employment	Data at firm level
Ellery (2017): overall economy	GDP at constant prices, from National Accounts at IBGE.	Stock of capital, calculated using the method of investment and depreciation.	Hours worked	0.4
Gomes, Pessoa, and Veloso (2003): overall economy	GDP	Stock of capital, calculated using the method of investment and depreciation.	Employed personnel	0.4
BONELLI and FONSECA (1998)[1]: manufacturing sector	Physical production OR value added	Electricity consumption, from Eletrobras	Employed personnel in manufacturing	0.6

[1]Based on section 4.2 (TFP for the manufacturing sector).
[2]As observed by Bonelli and Fonseca (1998), when we use Gross Revenue as a proxy for Y we need to include intermediate goods in the equation. Gazzoli, Emerson, and Messa, Alexandre (2017) included this variable and also used it as an instrumental variable for their econometric specification.

As seen, for the manufacturing sector in Brazil "α" have been usually estimated as 0.6, while for the whole economy it is around 0.4. We will then use 0.6 as the share of capital in the income of the automotive sector in Brazil. For "Y" we use the value added (value of industrial transformation, from PIA/IBGE), for "K" we use energy consumption (electricity and fuel)[152], for "L" we use the total employment in production on 31/December for each year[153]. Our data covers from 1996 to 2017.

Graph 21 – Labour productivity and capital intensity – automotive sector



Source: Own elaboration

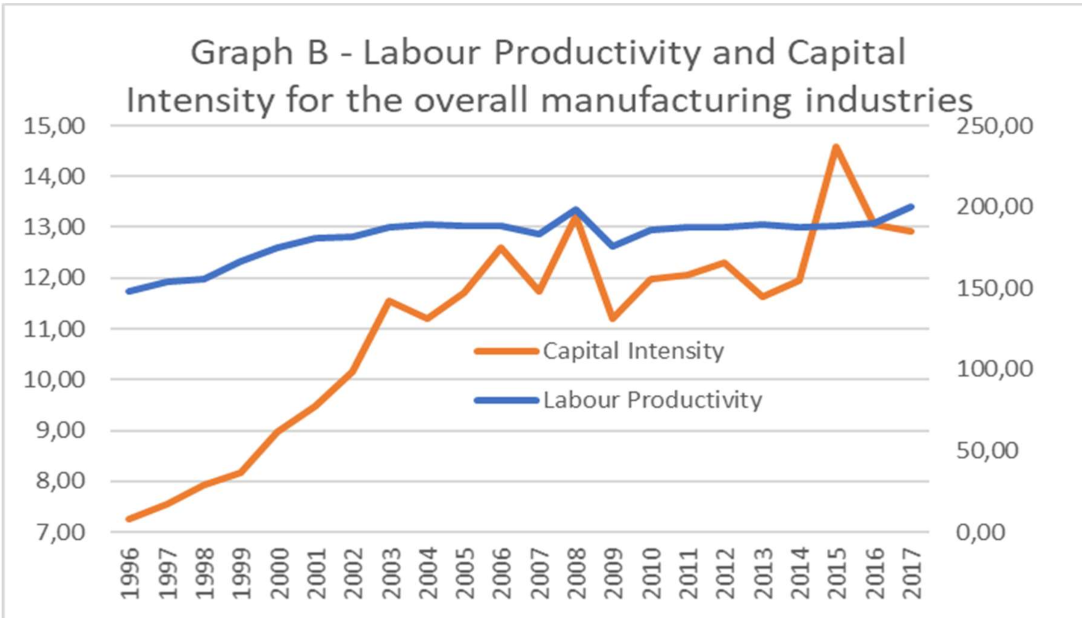
As can be seen from graph "21", labour productivity increase from 1996 to 2008 can be almost entirely explained by the increase in capital intensity. Similarly, labour productivity decreasing from 2008 to 2015 can be explained by the fall in capital intensity. In comparison with the overall manufacturing industry, the automotive sector is a capital-intensive industry, and thus it is expected that labour productivity is significantly affected by the intensity in capital using. If we look at the overall

[152] This measure is better than the stock of capital or the investment in machines, as electricity and fuel used in production can account for idle capacity.

[153] Initially we would use the average employment in production, but there is an important break in 2007, when IBGE moves from CANE 1.0 to CNAE 2.0. The measure used instead does not present such problem. However, we acknowledge that would be better to use a measure of the number of hours worked, as this would account for differences in working hours. Moreover, we did not adjust it for changes in human capital.

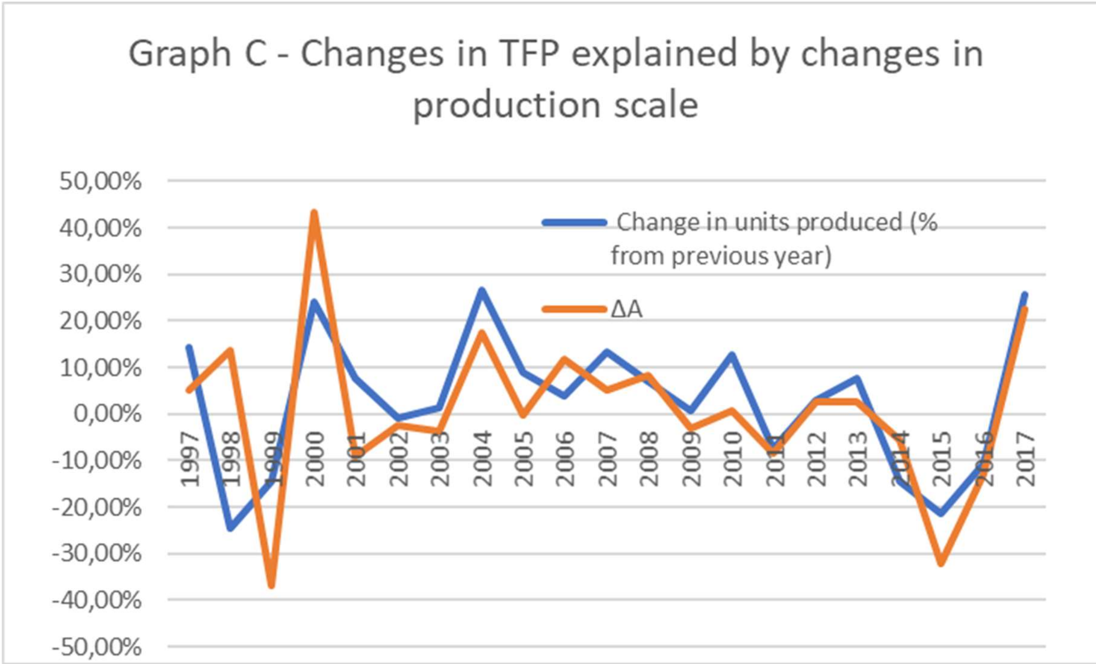
manufacturing in Brazil, this relationship is weaker: labour productivity increased at a much slower pace than capital intensity (graph "22").

Graph 22 – Labour productivity and capital intensity – overall manufacturing



TFP variation can be explained by the changes in production scale. Graph "23" shows a very synchronized path between these two variables, and the relatively small differences could be easily attributed to measurement error.

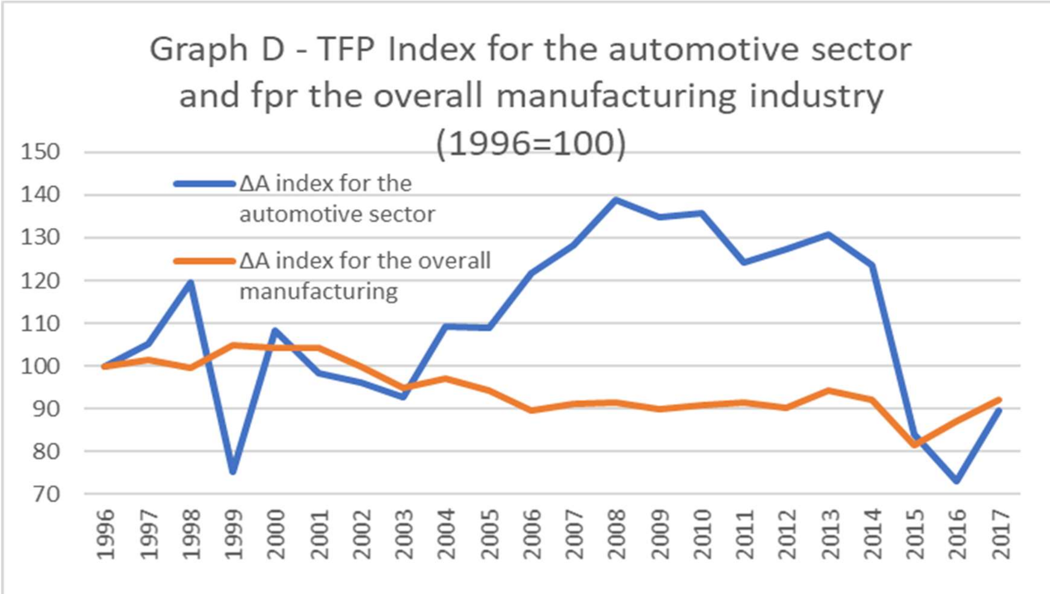
Graph 23 – Changes in TFP explained by changes in production scale



The first conclusion from this is that scale of production was the main driver of both TFP and labour productivity (through capital intensity) for the Brazilian automotive sector.

In this sense, the data does not allow us to observe trends for TFP or labour productivity, free from the effect of changes in production scale. We can, however, compare the evolution of the TFP index for the automotive sector and for the overall manufacturing industry. Graph "24" does this. What can be observed is that the automotive industry strongly increased its scale (and thus its TFP) from 2005 to 2014, followed by a steep fall in 2014-2016. The overall manufacturing industry has been showing a decrease in TFP since 1999. This can corroborate the argument that the automotive sector was the beneficiary of several subsidies and industrial policies aimed to foster its scale, but these were short-lived, as the sector suffered relatively more in the following 2014-2016 crisis.

Graph 24 – TFP index for the automotive sector and for the overall manufacturing sector



<u>Conclusions from this section</u>

Labour productivity increase from 1996 to 2008 can be almost entirely explained by the increase in capital intensity, and labour productivity decreasing from 2008 to 2015 can be explained by the fall in capital intensity[154]. In comparison with the overall manufacturing industry, the automotive sector is a capital-intensive industry, and thus it is expected that labour productivity is significantly affected by the intensity in capital using. If we look at the overall manufacturing in Brazil, this relationship is weaker: labour productivity increased at a much slower pace than capital intensity.

Thus, within the Brazilian automotive sector, between 1996 and 2017, labour productivity can be explained by changes in capital intensity. Total Factor Productivity, however, seems to do not have contributed to the overall productivity, as most of the variation follows the changes in production scale. The automotive industry strongly increased its scale (and thus its TFP) from 2003 to 2008, followed by a period of small falls and then a steep fall in 2014-2016. Meanwhile, the overall manufacturing industry has been showing a decrease in TFP since 1999. This can corroborate the argument

[154] This was probably the result of an increase in the number of workers that was higher than the increase in total value-added.

that the automotive sector was the beneficiary of several subsidies and industrial policies aimed to foster its scale, but these were short-lived, as the sector suffered relatively more in the following 2014-2016 crisis.

Apart from the very early years after the trade liberalization of 1990`s, since then very little changed in terms of efficiency (TFP). Apparently, production scale is the main driver for productivity in the automotive sector in Brazil.

6.6 – Linear regression analysis (multifactorial)

As we cannot use randomized experiments (experimental design), we need to take into consideration all variables that could have an important effect on the dependant variable, either directly or indirectly. The methods to be deployed here can be classified as quasi-experimentals. They can only infer causality, never prove it. However, we do can obtain a stronger claim if we make a proper use of the best available methods in conjunction with an underlying context, based both on theory and other data sources. This will allow us to interpret the results even if they are statistically fragile, as our sample size is quite small. As we work with only 23 annual observations, we need to use the minimum number of explanatory variables and also interpret the statistical results with more leniency. To achieve this, the relationships among all variables needs to be understood to a high degree, meaning that our statistical tests need to be well grounded by either theory or strong empirical evidence, even by observation. This, together with the timing order, also helps to assess the direction of causality.

The understanding of each variable under use comes from our literature review, our interviews (qualitative chapter) and the previous subsections of this quantitative chapter.

Thus, complementing the statistical analysis developed in the previous subsections, we now use quantitative data to perform a linear regression analysis. The aim is still to describe relationships among variables of interest, seeking evidence of potential causal relationships (although, as explained before, this is never adamant without a randomized control trial). We are not interested in estimation for predicting future values, therefore our chosen techniques need only to give us insights about the statistical significance and the direction of effect (signal of the variable).

We test both univariable and multivariable regressions. Although linear regression is able to show the individual effects of each explanatory variable on the explained variable, any combined contribution (linear relationship) from any two or more explanatory variables will be not counted as an individual effect of any of those variables. Thus, if there is a high degree of linear relationship among the chosen explanatory variables, the model will lose explanatory power. On the other hand, with lower degrees of linear relationship among the explanatory variables, a more complete model (with more explanatory variables) may not only give us the effect of the other variables, but also better explain the true effect of the variable previously taken as the only explanatory variable in a univariate regression.

In other words, as stated in Kennedy (2008)[155]: using separated equations, each for a different explanatory variable, can generate more bias because all collinear effects of the omitted variables could be captured by the explanatory variable[156]. However, using a multivariable single equation could increase our variance, as the combined effects of any linearly related variables would be discharged. As best practice we therefore need to either ensure that our explanatory variables are not strongly linearly related or proceed using separated equations.

First, we will present the models tested that did not perform well, or the specifications that could be useful to our study but were not pursued because of data limitations. This exposition can provide some insights from the unsuccessfully specifications and tests. Later, we present the tests and results we consider as meaningful, from the point of view of getting more evidence to understand overall relationships. As explained

[155] Kennedy, Peter. A Guide to Econometrics, 6th edition. 2008
[156] The information that is not colinear and belongs to omitted variables would be reflected in the error term.

before, we are not interested in make predictions or in assess the exact size of any parameter – therefore, our data limitations are not that limiting for our purposes.

Equations not successfully specified and tested

Our variables of interest were chosen on the basis of what was suggested by our previous analysis as important, but we needed to confront this with data availability. Based on the qualitative and quantitative results obtained so far, the main dependent variables we would be interested in are proxies for competitiveness and market behavior. Focusing on the dynamics of the Brazilian automotive sector and given data constraints we therefore had the following options:

a) A time series to explain our calculated TFP variation as a function of variation in the foreign competition, in the domestic competition, in the scale of production, and also the Program Inovar-Auto. For proxy for foreign competition we have a variable comprising the real effective exchange rate and the tariffs applied to vehicle imports. Domestic competition is proxied by our calculated concentration index – HHI. Total scale of production is the direct measure used in previous subsections and that seemed to be the most important driver for TFP. However, we believe that the variable related to competition would have to be lagged in order to impact TFP, as this productivity measure is arguably the result of advancements in technology potentially driven by learning from workers and managers and also implementation of new techniques and tools. All this is supposed to take some time to respond to competition, while the effects of scale would be more direct. Given our annual data limited number of observations any lagged variable will reduce our degrees of freedom. Therefore, we applied just one-year lag for both REER+TARIFS and HHI. We chose to use the variation of variables, instead of the level variables. Our model was:

$$\Delta TFP_t = \alpha_t + \beta_{1t-1}\Delta(REER + tariffs) + \beta_{2t-1}\Delta(HHI) + \beta_{3t}\Delta(Total\ scale) + \mu + \varepsilon$$

Where:

- TFP: total factor productivity

- REER+tariffs: the sum of the real effective exchange rate and the import tariffs applied for final goods (cars) – it is our proxy for foreign competition
- HHI: Concentration index for the domestic market production of cars and light commercials – It is our proxy for domestic competition.
- Total scale: total scale of cars and light commercial production in Brazil – it is our proxy for costs.

This model aimed to provide evidence of the relative importance of total scale, domestic competition, and foreign competition (real or potential), on TFP. If total scale was confirmed to be the main – or the sole, driver of TFP, as suggested by the previous subsection, we would have more evidence that there was no real technological advance applied in the goods of the process of car production in Brazil other than the ones resulting from a better allocation of production factors allowed by scale or a higher capital intensity. .

However, the model did not perform well. There was unit root even using differencing variables, and the coefficients were not significant.

b) A time series to explain domestic prices

Based on the previous data we considered that would be insightful to make a multifactorial analysis to test the relative importance of domestic competition and foreign competition, to the prices and to the mark-ups of automakers. As proxy for foreign competition we would use either a combination of exchange rate and tariffs, or the import penetration coefficient. The first option is indirect but can encompass potential foreign competition. The second option is direct but can include imports by the domestic automakers that do not compete with domestic production in a stricter sense. For domestic competition, our proxy is the HHI index.

The equations would have other explanatory variables, to control for other important sources of price or markup variation, but also to test the relative importance of these sources as well: a measure of the total scale in the industry, to capture eventual costs savings given economies of scale; and the GDP as a proxy for demand. The scale measure, as a variable that impacts costs, is expected to impact markups, but not necessarily prices, as the industry is not under perfect competition (price is not equal to marginal cost).

We also could add a dummy variable to test for the effects of Inovar Auto. However, as we are working with annual observations between 1996 and 2017, and the Program was in place between 2012 and 2017, the number of observations is probably too small to meaningfully test this effect. Nonetheless, the signal of the dummy could at least indicate if the policy was important enough to have had some impact on prices or markups. This suspicion about its impact comes from the potential prominence of exchange rate movements: a) Inovar Auto just added tariff protection to an exposed domestic market, suffering from imports brought by an overvalued Real, in 2012/2013, thus potentially only contributing to cease the growth of imports in the first two years; b) but since 2013/2014 the Real started its devaluation and then Inovar tariffs could be simply redundant, given the exchange rate levels; c) our interviews pointed that Inovar Auto successfully stopped the imports of low-cost Chinese cars. But these were just part of the overall imports. Thus, regressing this dummy variable to the prices or markups of the entire domestic industry is expected to generate either non-significant results or a very small value.

The specifications we tested involved as dependent variables: constant car prices; mark-ups for cars; and mark-ups for autoparts. We tested all of them both as level and as variation. The first model was

$$\begin{aligned}\Delta Constant\ car\ prices_t &= \alpha_t + \beta_{1t}\Delta(REER + tariffs) + \beta_{2t}\Delta(HHI) + \beta_{3t}\Delta(Total\ scale)\\ &+ \beta_{4t}\ (Inovar - Auto) + \beta_{5t}\Delta(GDP) + \mu + \varepsilon\end{aligned}$$

$$\begin{aligned}Constant\ car\ prices_t &= \alpha_t + \beta_{1t}(REER + tariffs) + \beta_{2t}(HHI) + \beta_{3t}(Total\ scale)\\ &+ \beta_{4t}\ (Inovar - Auto) + \beta_{5t}(GDP) + \mu + \varepsilon\end{aligned}$$

The model was not significant overall. Prices are relatively stable in the short run. Moreover, HHI has a downward trend, while total scale an upward trend, making very difficult to have any impact of both variables on a relatively constant dependent variable such as car prices.

Equations specified and tested

The last model tested were the ones with "markup" as the dependent variable. This was calculated using data from PIA/IBGE, considering all manufacturing firms with more than 5 employees operating in the sector under study, in the following way:

$$\frac{\text{(Total gross revenue of industrial goods (R\$) – Total costs and expenses (R\$))}}{\text{(Total costs and expenses (R\$))}}$$

However, we reckoned that this variable is problematic. One reason for this is that markups may measure only a "dirty" competitiveness, as they usually follow the business cycle, thus not being a good proxy for competitiveness. Moreover, markups can be an indicator of market power with very few relation to competitiveness. Finally, as the markup measures collected from IBGE are the ones derived from what the firms declare, there may be accounting practices and incentives that make profits appear to be smaller than what they really are.

1) Markup for cars and light commercials

$$MarkupCars_t = a_t + \beta_{1t}\,(REERtariffs) + \beta_{2t}\,(HHI) + \beta_{3t}\,(Totalscale) + \beta_{4t}\,(Inovar) + \mu + \epsilon$$

$$\Delta MarkupCars_t = a_t + \beta_{1t}\,\Delta(REERtariffs) + \beta_{2t}\,\Delta(HHI) + \beta_{3t}\,\Delta(Totalscale) + \beta_{4t}\,\Delta(Inovar) + \mu + \epsilon$$

The basic characteristics of the data is in the summary table 21:

Table 21

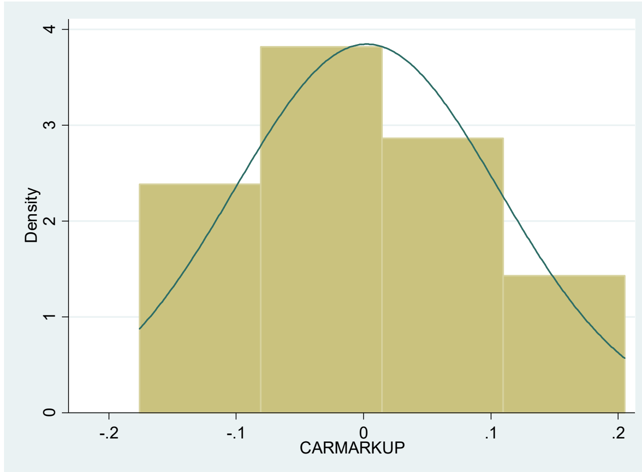
```
. summarize
```

Variable	Obs	Mean	Std. Dev.	Min	Max
Time	23	2007	6.78233	1996	2018
CARMARKUP	22	.0024674	.1036974	-.1759663	.2049696
DUMMYINOVAR	23	.2608696	.4489778	0	1
REERTARIFFS	23	1.820614	.321951	1.294704	2.422167
HHI	23	2020.273	512.1239	1198.653	2928.084
YTOTAL	23	2399855	668380	1281463	3494014

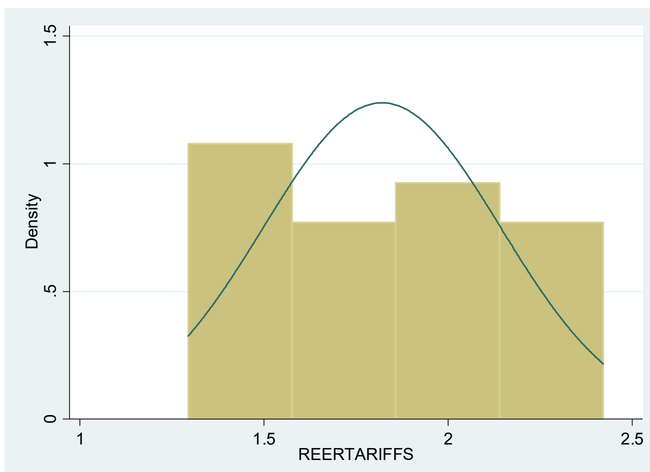
The list and details of each variable is the following:

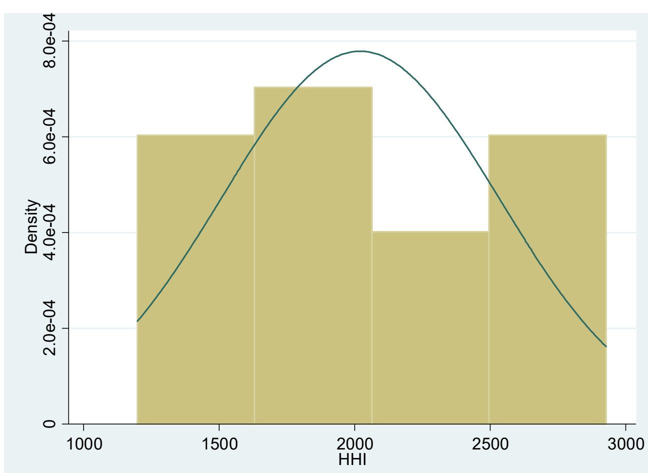
- REERTARIFFs is a combination of exchange rates and tariffs. When this variable increase, it means that the Brazilian Real lost value. Tariffs are treated as another layer of this loss of domestic currency value, as both movements make imports less competitive.
- HHI is just the measure of concentration: a lower HHI means lower concentration.
- Ytotal is the total scale of production of all automakers together.
- Dummy Inovar is a dummy for the years were Inovar Auto was valid.

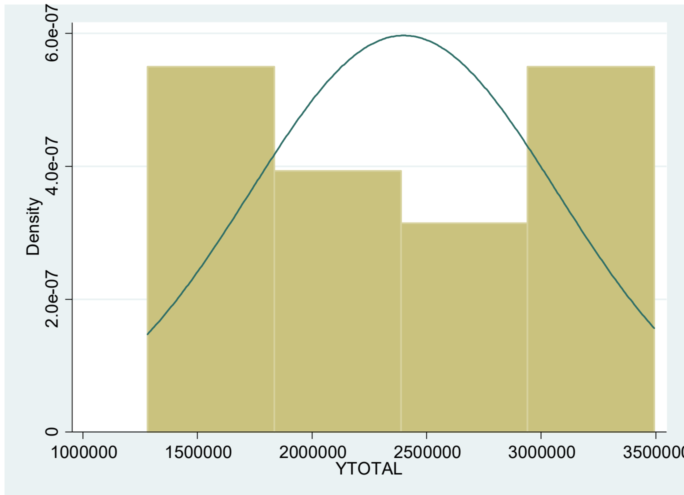
From inspection of the graph, our dependent variable is normally distributed.



However, neither of the independent variables is normally distributed:







Thus, our t-statistics would be inefficient, and a parameter significance needs to be seen as just loosely indicative.

1.1 Full multivariate model:

Table 22

```
. reg CARMARKUP DUMMYINOVAR REERTARIFFS HHI YTOTAL
```

Source	SS	df	MS			
				Number of obs	=	22
				F(4, 17)	=	6.83
Model	.139225247	4	.034806312	Prob > F	=	0.0018
Residual	.086590818	17	.005093578	R-squared	=	0.6165
				Adj R-squared	=	0.5263
Total	.225816065	21	.010753146	Root MSE	=	.07137

CARMARKUP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DUMMYINOVAR	-.0613633	.0556291	-1.10	0.285	-.1787304	.0560038
REERTARIFFS	-.0730251	.0683744	-1.07	0.300	-.2172824	.0712322
HHI	.000085	.000066	1.29	0.215	-.0000542	.0002241
YTOTAL	9.74e-08	4.09e-08	2.38	0.029	1.11e-08	1.84e-07
_cons	-.2543192	.3083278	-0.82	0.421	-.9048339	.3961956

```
. estat hettest, mtest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CARMARKUP

         chi2(1)      =     1.03
         Prob > chi2  =   0.3098

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CARMARKUP

         chi2(1)      =     1.03
         Prob > chi2  =   0.3098

. estat dwatson

Durbin-Watson d-statistic(  5,    22) =  1.842821
```

There is no evidence of heteroskedasticity neither evident autocorrelation.

The model is jointly significant (F statistic is significant at 1%) and has a high R2 of 62%. However, all variables apart the total scale are statistically insignificant. Despite this, as our independent variables are not normally distributed, we may have flawed t-tests.

Moreover, the correlation matrix among the independent variables show that some of these are strongly correlated, and therefore the model presents higher variance due to the very small amount of information left in the data, after the model discount all collinear movements of each pair of variables.

Table 23

	REERTARIFFS	HHI	YTOTAL	Dummy Inovar
REERTARIFFS		-0.1364	-0.4507	0.2595
HHI	-0.1364		-0.6068	-0.6850
YTOTAL	-0.4507	-0.6068		0.3584
Dummy Inovar	0.2595	-0.6850	0.3652	

Inovar Dummy and HHI are the highest correlation, but all others have relatively high correlations as well, indicating that, given the low amount of data we need to be very parsimonious. Therefore, to provide insights beyond a simple correlation (provided by a univariate model), we chose to run the following models with two independent variables:

MARKUPcars = f(REERTARIFS + HHI), to assess the relative importance of foreign and domestic competition;

MARKUPcars = f(REERTARIFS + TotalScale), to assess the relative importance of prices and costs;

MARKUPcars = f(REERTARIFS + Inovar), to assess the relative contribution of Inovar Auto, beyond the exchange rate movements.

1.2 MARKUPcars = f(REERTARIFS + HHI)

Table 24

```
. reg CARMARKUP REERTARIFFS HHI
```

Source	SS	df	MS			
				Number of obs	=	22
				F(2, 19)	=	7.85
Model	.102155004	2	.051077502	Prob > F	=	0.0033
Residual	.123661061	19	.006508477	R-squared	=	0.4524
				Adj R-squared	=	0.3947
Total	.225816065	21	.010753146	Root MSE	=	.08068

CARMARKUP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
REERTARIFFS	-.1980338	.0544687	-3.64	0.002	-.3120382	-.0840294
HHI	.000033	.0000362	0.91	0.375	-.0000429	.0001088
_cons	.2963635	.1354924	2.19	0.041	.0127747	.5799522

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CARMARKUP

         chi2(1)      =     0.03
         Prob > chi2  =   0.8593

. estat hettest, mtest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CARMARKUP

         chi2(1)      =     0.03
         Prob > chi2  =   0.8593

. estat dwatson

Durbin-Watson d-statistic(  3,    22) =  1.525813
```

There is evidence of some autocorrelation, as would be expected from the deliberate omission of variables.

The model is jointly significant (F statistic is significant at 1%) and has a high R2 of 45%, lower than the full model, as expected. The variable that accounts for exchange rates and tariffs (REERTARIFS) is significant at 1%, while HHI is not significant. The signal of REERTARIFFS is negative, meaning that a loss in the value of the Real reduce markups. This would not be expected if one thinks that a devaluation of the currency – or the imposition of more tariffs, would make imports less competitive and therefore increase markups. However, as most imports that follow an exchange rate valuation are made by domestic automakers, these imports contribute to their markups. Our results are then an evidence that the automakers with operations in Brazil can benefit from currency appreciations – at least up to a point. This caveat is important because, from the interviews and from earlier quantitative results we realized that when the exchange rate is very overvalued it becomes profitable for independent importers to start importing, even with all extra costs involved in terms of marketing and setting low scale operations. Moreover, an increase in the value of the exchange rate also reduce the costs of production – one of the two components of the markup.

Therefore, foreign competition from automakers without operations in Brazil are verified only when the exchange rate is relatively sufficiently overvalued, while domestic competition do not seems to have impacted domestic markups. Therefore, this is another evidence that automakers compete in quality, not price.

1.3 MARKUPcars = f(REERTARIFS + TotalScale)

Table 25

```
. reg CARMARKUP REERTARIFFS YTOTAL

      Source |       SS           df       MS      Number of obs   =        22
-------------+----------------------------------   F(2, 19)        =      7.50
       Model |  .099593704         2  .049796852   Prob > F        =    0.0040
    Residual |  .126222361        19  .006643282   R-squared       =    0.4410
-------------+----------------------------------   Adj R-squared   =    0.3822
       Total |  .225816065        21  .010753146   Root MSE        =    .08151

------------------------------------------------------------------------------
   CARMARKUP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 REERTARIFFS |  -.1891897   .0605073    -3.13   0.006    -.3158329   -.0625465
      YTOTAL |   1.90e-08   2.92e-08     0.65   0.523    -4.21e-08    8.02e-08
       _cons |   .3025878   .1556622     1.94   0.067    -.0232168    .6283925
------------------------------------------------------------------------------

. estat dwatson

Durbin-Watson d-statistic(  3,    22) =  1.795112

. estat hettest, mtest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CARMARKUP

         chi2(1)      =     0.39
         Prob > chi2  =   0.5319
```

A weaker evidence of autocorrelation, but no heteroskedasticity.

Again, the model is jointly significant (F statistic is significant at 1%) and has a high R2 of 44%. The variable REERTARIFS is significant at 1%, while total scale (Ytotal) is not significant. The signal of REERTARIFFS is still negative, as explained above. Total scale affects costs, while the exchange rates and tariffs, as explained in the previous item, can also affect costs, because most imports are made by the same automakers that manufacture domestically. In this sense, given the previous results and insights, we cannot compare effects through costs to effects through prices.

1.4 MARKUPcars = f(REERTARIFS + Inovar)

Table 26

```
. reg CARMARKUP REERTARIFFS DUMMYINOVAR

      Source |       SS           df       MS      Number of obs   =        22
-------------+----------------------------------   F(2, 19)        =      8.99
       Model |  .109799892         2  .054899946   Prob > F        =    0.0018
    Residual |  .116016172        19  .006106114   R-squared       =    0.4862
-------------+----------------------------------   Adj R-squared   =    0.4322
       Total |  .225816065        21  .010753146   Root MSE        =    .07814

------------------------------------------------------------------------------
   CARMARKUP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 REERTARIFFS |   -.187031   .0536609    -3.49   0.002    -.2993445   -.0747174
 DUMMYINOVAR |  -.0564528   .0386511    -1.46   0.160    -.1373505    .0244448
       _cons |   .3594416     .09733     3.69   0.002     .1557274    .5631557
------------------------------------------------------------------------------
```

```
. estat hettest, rhs

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: REERTARIFFS DUMMYINOVAR

         chi2(2)      =     1.32
         Prob > chi2  =   0.5178

. estat dwatson

Durbin-Watson d-statistic(  3,    22) =  1.795112
```

No heteroskedasticity and just a weak autocorrelation.

Again, the model is jointly significant (F statistic is significant at 1%) and has a high R2 of 49%. The variable REERTARIFS is significant at 1%, while the Inovar-Auto is not significant. The signal of REERTARIFFS is still negative, as explained above.

Therefore, the evidence points to a non-contribution of Inovar on markups. This can be explained because as said before, domestic automakers benefit from exchange rate movements altering their mix of imports/domestically produced vehicles, while Inovar just added protection against third-country imports, without improving the conditions for imports by domestic automakers. Domestic automakers were allowed to import, under a quota, without paying the extra tariffs brought by Inovar-Auto. Moreover, as explained in the previous chapters, Inovar-Auto was designed to protect the market from new chines imports, what in fact happened. But this fact does not allow to have a counterfactual to test, as there was not enough time for pre-Inovar-Auto Chinese imports to affect domestic markups in 2010.

We now turn to the autopart sector.

2) Markup for autopart producers

$$MarkupAutoparts_t = a_t + \beta_{1t}\,(REERtariffs) + \beta_{2t}\,(HHI) + \beta_{3t}\,(Totalscale) + \beta_{4t}\,(Inovar) + \mu + \epsilon$$

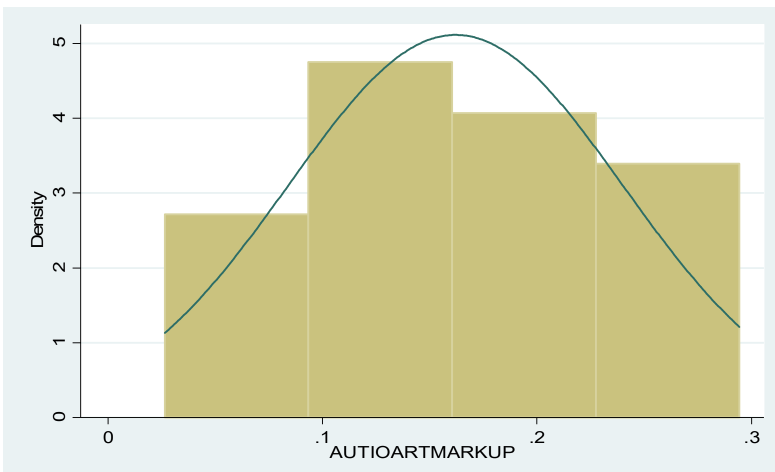
$$\Delta MarkupAutoparts_t = a_t + \beta_{1t}\,\Delta(REERtariffs) + \beta_{2t}\,\Delta(HHI) + \beta_{3t}\,\Delta(Totalscale) + \beta_{4t}\,\Delta(Inovar) + \mu + \epsilon$$

Table 27

```
. summarize
```

Variable	Obs	Mean	Std. Dev.	Min	Max
Time	23	2007	6.78233	1996	2018
AUTIOARTMA~P	22	.1620344	.0780206	.0264483	.2943843
DUMMYINOVAR	23	.2608696	.4489778	0	1
REERTARIFFS	23	1.820614	.321951	1.294704	2.422167
HHI	23	2020.273	512.1239	1198.653	2928.084
YTOTAL	23	2399855	668380	1281463	3494014

From inspection of the graph, our dependent variable is approximately normally distributed. There is no need for a normally distributed independent variable:



2.1 Full multivariate model:

Table 28

```
. reg AUTIOARTMARKUP DUMMYINOVAR REERTARIFFS HHI YTOTAL

      Source |       SS           df       MS      Number of obs   =        22
-------------+----------------------------------   F(4, 17)        =     28.43
       Model |  .111205034         4  .027801258   Prob > F        =    0.0000
    Residual |  .016626425        17  .000978025   R-squared       =    0.8699
-------------+----------------------------------   Adj R-squared   =    0.8393
       Total |  .127831459        21  .006087212   Root MSE        =    .03127

------------------------------------------------------------------------------
AUTIOARTMA~P |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 DUMMYINOVAR |  -.0665338   .0243762    -2.73   0.014     -.117963   -.0151045
 REERTARIFFS |  -.0254041    .029961    -0.85   0.408    -.0886163    .0378082
         HHI |   .0000204   .0000289     0.71   0.490    -.0000406    .0000814
      YTOTAL |   1.11e-07   1.79e-08     6.20   0.000     7.33e-08    1.49e-07
       _cons |   -.080165   .1351065    -0.59   0.561    -.3652147    .2048848
------------------------------------------------------------------------------
```

There is no strong evidence of residual autocorrelation (DB statistic is close to 2) neither of heteroskedasticity (p-value in the Breusch Pagan test is higher than 0.05).

```
. estat dwatson

Durbin-Watson d-statistic(  5,    22) =  2.152947

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of AUTIOARTMARKUP

         chi2(1)      =     1.50
         Prob > chi2  =   0.2212
```

The model is jointly significant (F statistic is significant at 1%) and has a very high R2 of 87% - thus almost all variations in the markups for the autopart sector could be explained by the variables in the model. However, only two independent variables are statistically insignificant: Dummy Inoavr-Auto and Total scale (Ytotal). Despite this, as our independent variables are not normally distributed, we may have flawed t-tests. These results are not only very different from the case for automakers, but also encompass a different interpretation: this complete model suggests that the concentration among automakers do not affect the markup of autopart producers. This is expected, as each autopart producer has long-term supply contracts with automakers, thus being a variable not directly related to the concentration degree of the final buyers. However, the statistical insignificance could be the result of collinearity, as explained before, as the insignificance of the exchange rate is likely to be, as well.

The correlation matrix among the independent variables is the same as before (table 23), as the only difference between these two models is the dependent variable – automakers or autoparts. Therefore, the candidates to be dropped because of high correlation are the same: Inovar X HHI and Ytotal X HHI.

Thus, we proceed similarly as in the previous models, running bivariate models:

MARKUPautoparts = f(REERTARIFS + HHI), to assess the relative importance of foreign competition with autoparts and domestic concentration of automakers. These two variables were statistically insignificant in the full model;
MARKUP autoparts= f(REERTARIFS + TotalScale), to assess the relative importance of prices (competition with imported autoparts) and costs (purchase volumes from automakers);
MARKUPautoparts = f(REERTARIFS + Inovar), to assess the relative contribution of Inovar Auto, beyond the exchange rate movements.

2.2 MARKUPautoparts = f(REERTARIFS + HHI).

Table 29

```
. reg AUTIOARTMARKUP REERTARIFFS HHI

      Source |       SS           df       MS      Number of obs   =        22
-------------+----------------------------------   F(2, 19)        =      9.49
       Model |  .06388619         2  .031943095   Prob > F        =    0.0014
    Residual |  .063945269        19   .00336554   R-squared       =    0.4998
-------------+----------------------------------   Adj R-squared   =    0.4471
       Total |  .127831459        21  .006087212   Root MSE        =    .05801

------------------------------------------------------------------------------
AUTIOARTMA~P |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 REERTARIFFS |  -.1674039   .0391683    -4.27   0.000    -.2493842   -.0854236
         HHI |  -.0000413   .0000261    -1.59   0.129    -.0000959    .0000132
       _cons |   .5527328   .0974322     5.67   0.000     .3488048    .7566607
------------------------------------------------------------------------------

. estat dwatson

Durbin-Watson d-statistic(  3,    22) =  .9360439

. estat hettest, rhs

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: REERTARIFFS HHI

         chi2(2)      =     3.50
         Prob > chi2  =   0.1737

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of AUTIOARTMARKUP

         chi2(1)      =     2.15
         Prob > chi2  =   0.1428
```

There is evidence of autocorrelation. This is expected, as we know that some variables were omitted. The implication is that our hypothesis tests are not efficient anymore, because our parameter estimations are biased.

The model is jointly significant (F statistic is significant at 1%) and has a high R2 of 50%. The two variables were statistically insignificant in the full model, but now the exchange rate (REERTARIFFS) is significant at 1%. This is probably due to a high correlation with Total scale, that is not present in this bivariate model. The signal is negative, however. Even considering that a devaluation of the Real (a higher REERTARIFFS) could reduce the markups because it increases production costs, the net effect should positive (accounting for less competition with imported autoparts and also more exports). Therefore, we suppose the model is biased because of omitted variables. In this sense, we cannot use the full model (because of collinearity problems) neither this bivariate model (because of omitted variable problems). We therefore test another bivariate model, without HHI, that was insignificant and is also very correlated with both Inovar-Auto and Total scale.

2.3 MARKUP autoparts= f(REERTARIFS + TotalScale)

Table 30

```
. reg AUTIOARTMARKUP REERTARIFFS YTOTAL

      Source |       SS           df       MS      Number of obs   =        22
-------------+----------------------------------   F(2, 19)        =     26.71
       Model |  .094291119         2  .04714556    Prob > F        =    0.0000
    Residual |   .03354034        19 .001765281    R-squared       =    0.7376
-------------+----------------------------------   Adj R-squared   =    0.7100
       Total |  .127831459        21 .006087212    Root MSE        =    .04202

------------------------------------------------------------------------------
AUTIOARTMA~P |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 REERTARIFFS |  -.0912748   .0311906    -2.93   0.009    -.1565574   -.0259922
      YTOTAL |   7.07e-08   1.51e-08     4.69   0.000     3.92e-08    1.02e-07
       _cons |   .1601911   .0802414     2.00   0.060    -.0077561    .3281384
```

The model is jointly significant (F statistic is significant at 1%) and has a very high R2 of 73%. The two variables were statistically significant at 1%, but the exchange rate (REERTARIFFS) is still negative.

```
. estat hettest, rhs

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: REERTARIFFS YTOTAL

         chi2(2)      =    12.16
         Prob > chi2  =   0.0023
```

However, there is evidence of heteroskedasticity. Therefore, we run a robust standard error estimation:

Table 31

```
. regress AUTIOARTMARKUP REERTARIFFS YTOTAL, vce(robust)

Linear regression                               Number of obs     =         22
                                                F(2, 19)          =      75.29
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7376
                                                Root MSE          =     .04202
```

AUTIOARTMA~P	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
REERTARIFFS	-.0912748	.0396701	-2.30	0.033	-.1743052	-.0082444
YTOTAL	7.07e-08	8.00e-09	8.83	0.000	5.39e-08	8.75e-08
_cons	.1601911	.0770827	2.08	0.051	-.0011449	.3215271

The results are similar.

Conclusions of this section

We have limitations in terms of data availability and therefore the results were analyzed with this in mind and with the proper care and pint of salt. However, we can offer some indications, or suggestions of possible insights.

For automakers, Inovar-Auto just avoided a potential influx of Chinese competition, being innocuous in relation to the other variables under test. More importantly, a loss in the value of the Real reduce markups. This would not be expected if one thinks that a devaluation of the currency – or the imposition of more tariffs, would make imports less competitive and therefore increase markups. However, as most imports that follow an exchange rate valuation are made by domestic automakers, these imports contribute to their markups. Our results are then an evidence that the automakers with operations in Brazil can benefit from currency appreciations – at least up to a point. This caveat is important because, from the interviews and from earlier quantitative results we realized that when the exchange rate is very overvalued it becomes profitable for independent importers to start importing, even with all extra costs involved in terms of marketing and setting low scale operations. Moreover, an increase in the value of the exchange rate also reduce the costs of production – one of the two components of the markup.

Therefore, foreign competition from automakers without operations in Brazil are verified only when the exchange rate is relatively sufficiently overvalued, while domestic competition does not seems to have impacted domestic markups. Therefore, this is another evidence that automakers compete in quality, not price.

For autopart producers, Inovar-Auto was not a good policy – it did not provide effective protection against imports, neither impacted positively on markups. This is in line with our interviews results. The most important factor to increase markups for autoparts is the growth in total production (demand) of automakers – a straightforward result. For the exchange rate, the effects are mixed, as with more imports from automakers`headquarters, there is smaller room for domestic supply of autoparts.

6.7 Overall conclusions from the chapter

Different measures generated different results of real prices` evolution for cars in Brazil from 1989 to 2018. The insight is that real prices went down during the trade liberalization process, and that they probably went up from 1997 to 2004 and down again from 2005 to 2014. Despite the magnitude of the numbers, their direction and correlations would suggest that the real price reductions were concentrated in the years of trade liberalization (1990-1994), and after 2004, when the automakers that came to Brazil in late 90s and early 2000s started to gain scale. However, exchange rates seem to have had a more important effect on the real price behaviour, adding to the effects of tariffs. Although import competition apparently had a stronger effect on domestic prices than domestic competition, it is not possible to disentangle these effects based solely on univariate analysis. Thus, we can only say that data from prices indicates a degree of competition within the domestic market and with imports. The oligopoly structure would be non-collusive, from this perspective.

Total production rose during the period, as also the number of domestic producers. The average scale per producer, a result from these two previous measures, showed an oscillated behaviour. In the qualitative chapter there was the argument that although new entrants may have increased domestic competition, these new entrants also contributed to reduce average scale vis a vis what would be observed without them. As said before, we need to develop a multivariate analysis to disentangle the effects.

Adjusted prices for Toyota Corolla, among all countries that produces the car, indicates that Brazil would be around the higher price portion of the sample, but it is still not on neither extreme. If we take into account the scale of production at model level (thus, the production of Corollas in the plant), Brazil seems to be very close to the trend line that relates price and scale. Therefore, it seems that inside the factory, Brazilian competitiveness is relatively well explained by its scale. However, once a vehicle departs the factory, transport costs and other types of costs related to the business environment can take a toll on this competitiveness.

The decisions of automakers and the evidence of the importance of scale seems converging. Thus, there is evidence that scale was, and it is still one of the main factors affecting competitiveness in an industry based on mass production and intensive in capital as the automotive one.

Tariffs and business environment seem to have a similar (in value) contribution to total costs, either for automakers or for autopart producers. The maximum direct cost reductions that would be possible with a zero-import tariff for inputs would be around 6%, for automakers and autopart producers alike. On the other hand, the maximum direct cost reductions that would be possible with a zero interest rates (a proxy for the ceiling in terms of business environment improvement) would be around 5,6% for automakers and 4,5% for autopart producers.

As said before, these cost reductions are only the direct ones. Such changes in tariffs and interest rates would affect the entire supply chain, thus potentially increasing the effect of cost reductions. Moreover, although we used interest rates as a proxy, there is scope for further improvements in the business environment affecting the cost of freight. Those values, seem similarly important in comparison to potential exchange rate variations: although Brazilian exchange rates can vary by far more than 6%, the net effect on competitiveness is always lower than the exchange rate variation itself, as it changes the costs for both the final goods and the inputs.

Within the Brazilian automotive sector, between 1996 and 2017, labour productivity can be explained by changes in capital intensity, and TFP can be explained by scale of production (in fact, capacity utilization). The automotive industry strongly increased its scale (and thus its TFP) from 2005 to 2014, followed by a steep fall in 2014-2016. Meanwhile, the overall manufacturing industry has been showing a decrease in TFP since 1999. This can corroborate the argument that the automotive sector was the beneficiary of several subsidies and industrial policies aimed to foster its scale, but these were short-lived, as the sector suffered relatively more in the following 2014-2016 crisis.

Overall, the picture that emerges from the data is that:

a) automotive production costs and productivity in Brazil are mainly determined by the scale of production;
b) prices are determined by the competition with imports, and thus by the exchange rate, despite the import tariffs of 35%;
c) Tariffs on imported inputs and a bad business environment seem to be similarly important in the cost structure of Brazilian automakers and autopart producers.

The behaviour of production in the past 30 years suggest limits for the domestic market scale, thus indicating that increase exports is necessary to gain competitiveness. On the other hand, domestic concentration indexes suggest that domestic competition do exist, although domestic prices are more affected by import competition. This happens even taking into consideration that most of the imports are made by automakers with domestic production.

The trade liberalization of early 90s reduced prices and increased quality but is not possible to affirm which factor was preponderant. However, after that shock, there is indication that competition between automakers in Brazil is based on quality/product, not price – in line with the monopolistic competition model. There is also some evidence that prices respond to total domestic scale.

If we consider that production within factories in Brazil are indeed in line with the costs expected given its scale, and that the main remaining factor contributing to a lower export competitiveness is the amount of tax that is not recoverable when exporting, this is an evidence that the business environment may have a bigger impact than other factors affecting competitiveness. However, the automakers are a sector that tend to suffer relatively less from the business environment, as they had access to foreign sources of capital at lower costs, or even domestic sources at subsidized costs (BNDES). This is not the case of smaller autopart producers.

Autopart producers are very heterogenous: some smaller firms struggle to survive, while others have markup levels potentially higher than those of automakers. However, we could not verify the impact that potential transfer-prices within automakers headquarters and its subsidiaries could have on the markup measure we obtained.

For automakers, Inovar-Auto just avoided a potential influx of Chinese competition, being innocuous in relation to the other variables under test. More importantly, a loss in the value of the Real reduce markups. This would not be expected if one thinks that a devaluation of the currency – or the imposition of more tariffs, would make imports less competitive and therefore increase markups. However, as most imports that follow an exchange rate valuation are made by domestic automakers, these imports contribute to their markups. Our results are then an evidence that the automakers with operations in Brazil can benefit from currency appreciations – at least up to a point. This caveat is important because, from the interviews and from earlier quantitative results we realized that when the exchange rate is very overvalued it becomes profitable for independent importers to start importing, even with all extra costs involved in terms of marketing and setting low scale operations. Moreover, an increase in the value of the exchange rate also reduce the costs of production – one of the two components of the markup.

Markups for automakers do oscillate in function of the industrial policies in place and accordingly to the domestic business cycle. This oscillation and domestic demand uncertainties may explain part of the relatively higher average of markup levels, in comparison with their operations in other countries, including headquarters. At the same time, this positive high markup average may explain the attractiveness of the domestic market to the new entrants in the past years.

CHAPTER 7 – CONCLUSION

In this conclusion we will compare and analyze the combined results of the literature review, the context data from chapter 4, the qualitative data study (interviews of chapter 5) and the quantitative exercises of chapter 6. The aim is to triangulate (secondary, primary qualitative and primary quantitative data) to gain further insights and answer our research questions.

This chapter is then organized under the following sub-headings, related to the theoretical framework developed in chapter 2 and to our research questions presented in chapter 1:

1. Competitiveness of the Brazilian auto industry
2. Channels linking trade policy and competitiveness
    a. Scale
    b. Foreign and domestic competition
    c. Access to technology and imported inputs
3. Business environment
4. Implications of new technologies and changes in industrial policymaking
5. Overall conclusions

1. Competitiveness of the Brazilian auto industry

According to the empirical literature, Total Factor Productivity in Brazil in the last 30 years has stagnated and is among the main causes for the low long-term economic growth in the country. The cause for the productivity stagnation is debatable, with the main hypotheses being (i) the low rates of entry and exit of firms, resulting in a lower average productivity, (ii) low investments, notably in R&D, caused by high interest rates; (iii) not enough incentives in a bad business environment[157], and, for some, (iv) an appreciated currency. The first explanation is subdivided into two main links: a) to the hypothesis of a bad business environment making more difficult both the entry and exit of firms; b) to an excessive level of protection, translated into low levels of competition.

Putting in another way, the literature could be summarized saying that the consequences of a bad business environment (including high interest rates and lower competition) can explain most of the productivity deficit

Our interviews pointed that the closeness of the economy, combined to the institutional difficulties to mergers and acquisitions, the weak infrastructure, the long geographical distances, and the relatively low average income make Brazil a location for production of "second class" vehicles, with an inferior price-quality combination. However, Brazilian automakers cannot be said to be uncompetitive. Provided the plant operate with enough scale, and the exports are correctly exempted from direct taxation, Brazilian-made vehicles are internationally competitive.

Moreover, the interviews pointed to an industry that is efficient inside the factory, but that loses this efficiency outside, due to business environment problems. However, there is qualitative evidence that there is a degree of skills shortage within firms, but productivity within automakers and tiers 1 and 2 is similar to the levels verified in developed countries. Therefore, the difference between the price and quality required for exporting, on the one hand, and that for the domestic market, on the other, must then be caused by a combination of bad domestic business environment, higher margins from the biggest firms, and a very inefficient operation on the part of the smaller autopart producers.

However, within the overall Brazilian automotive sector, TFP apparently did not change much in its own right, just varying in function of the scale of production. The automotive industry strongly increased its scale (and thus its TFP) from 2005 to 2014,

[157] Mainly R&D and startup incentives, but also includes other incentives related to the business environment besides the "entry and exit" umbrella and the interest rates.

followed by a steep fall in 2014-2016. Meanwhile, overall manufacturing industry has been showing a decrease in TFP since 1999. This can corroborate the argument that the automotive sector was the beneficiary of several subsidies and industrial policies aimed to foster its scale, but these were short-lived, as the sector suffered relatively more in the following 2014-2016 crisis.

As we are measuring TFP within the automotive sector, a stagnant TFP suggests that there is no movement of resources from the less productive to the more productive firms, neither much adoption of new technologies nor innovation. Given that the multinational automakers in Brazil have the knowledge of all innovations available in the world for the industry, our results suggest that the stagnant efficiency within automakers is the result of not enough adoption of new technologies in production, either due to supply side reasons (production costs) or to demand side reasons (not enough import competition or income to support enough scale for better equipped vehicles).

Therefore, the automotive sector in Brazil cannot be considered "infant" by any measure, as the biggest firms, with enough scale, in some models, can be quite competitive inside the factory. The reality is one of huge heterogeneity, and potentially high factor misallocation, caused by a combination of bad business environment, high overall levels of protection, and low levels of specialization.

2.a Channels linking trade policy and competitiveness: scale

One of the main questions raised by the literature is whether scale is promoted by trade protection or trade liberalization. It is straightforward to build a theoretical model showing that trade protection can allow the surviving of more firms and sectors within the protected domestic market. This would imply more scale of production for <u>more</u> sectors and firms that would not even exist under free trade. On the other hand, free trade could promote specialization and thus much more scale of production for <u>some</u> sectors and firms. This, of course, at the expense of the dying sectors and firms. The literature, however, adds more complex issues, such as the degree of importance of the existence of domestic suppliers to allow for the emergence of sectors and firms (potential positive impact), and also the costs implied by mandatory purchases of costly domestic inputs (potential negative impact). These considerations are related to the consequences of trade protection in terms of specialization and scale. Interviews showed a consistent line of argument favouring more specialization. Even as specialization can be achieved either with more or with less protection, it seems that focus on specific models, technologies, or stages of value chains, could promote dynamic gains in terms of competitiveness and growth. Complementing this discussion, more recent endogenous growth models point to the need of either more domestic or international integration, to foster scale gains and thus growth.

The intensification of moving production to domestic markets that shows more demand potential, and the willingness to increase sharing platforms among models, are indicators of the importance of economies of scale for car making. Thus, there is evidence that scale was, and still is one of the main factors affecting competitiveness in an industry based on mass production and intensive in capital as the automotive one.

So, besides the questions regarding "custo-brasil", the combined evidence from quantitative and qualitative sources suggest that protection, at least in the Brazilian case, generates less, and not more, overall scale of production. Moreover, the Brazilian market is not big enough to counterweight the average scale that is being observed in the global value chains. This is a phenomenon that, although not entirely new, is growing in importance.

In the interviews, it was mentioned that local content requirements should be set at levels that do not deviate too much from the scale of production of that good, in the country, thus confirming what the literature has to say about the risks of setting too high local content requirements. A clear message from the interviews is that Brazil should not produce everything, because it simply has not the required scale to do it competitively. Thus, a main policy question is to decide what would be produced locally – and what would not.

It was suggested by the interviews that the way forward is to increase scale through exports and specialization. This is also suggested by data: The behaviour of production in the past 30 years suggest limits for the domestic market scale, thus indicating that increase exports is necessary to gain competitiveness. For this, a careful trade liberalization, based on more trade agreements, would be paramount. The reasons are twofold: a) to increase competition pressures to force specialization on models where Brazil has more comparative advantages, such as small cars powered by hybrid electric-ethanol engines, and on specific autoparts and systems; b) to allow more market access to these Brazilian exports.

Overall, our quantitative data points to the fact that automotive production costs and productivity in Brazil are mainly determined by the scale of production. Adjusted prices for the Toyota Corolla, among all countries that produce the car, indicates that Brazil would be internationally competitive, at a given scale level: if we take into account the scale of production at model level (thus, the production of Corollas in the plant), Brazil seems to be very close to the trend line that relates price and scale. Therefore, it seems that inside the factory, Brazilian competitiveness is relatively well explained by its scale.

However, thanks to the already mentioned heterogeneity among firms in the sector, and also because of the combination of a bad business environment with overall high trade barriers, there is not enough entry and exit and many firms in the domestic market are not internationally competitive. The interviews pointed out that the Brazilian automotive sector has high production costs and lacks, in many subsectors or product ranges, enough scale to be internationally competitive.

2.b Channels linking trade policy and competitiveness: foreign and domestic competition

A strand of the literature reviewed in this thesis argues that in Brazil there are too many small firms because of barriers to entry and barriers to exit: protection against competition and even the bad business environment provides a barrier to entry, while subsidies to operate (tax breaks, access to privileged regulation etc) and institutional obstacles to mergers, acquisitions and closing of businesses provide barriers to exit. Many aspects of these barriers to entry and barriers to exit were confirmed by the interviews. Our interview results massively argue that weak competition (specially from imported final goods) allows less productive firms to stay in the market, while at the same time, firms are not pushed to export and increase their standards to the world frontier.

The literature suggests that the setting up of the Brazilian automotive sector was possible because Brazil defied comparative advantages in the 1950s, but also that there is no evidence of the costs in terms of distortion costs (foregone production in other sectors and income taken from consumers). More importantly, protection seems to have been too high for a too long time.

Different measures generated different results of real prices` evolution for cars in Brazil from 1989 to 2018. The insight is that real prices were reduced during the trade liberalization process, and that they probably increased from 1997 to 2004 and reduced again from 2005 to 2014. Despite the magnitude of the numbers, their direction and correlations would suggest that the real price reductions were concentrated in the years of trade liberalization (1990-1994), and after 2004, when the automakers that came to Brazil in late 90s and early 2000s started to gain scale. However, exchange rates seem to have had a more important effect on the real price behaviour, adding to the effects of tariffs. Although import competition apparently had a stronger effect on domestic prices than domestic competition, it is not possible to disentangle these effects based solely on univariate analysis. Thus, we can only say that data from prices indicates a degree of competition within the domestic market <u>and</u> with imports. The stability of market-shares is in line with what would be expected from an oligopolized market-structure. The only strong change came from a transference of market-share from Ford to some automakers that came to the Brazilian market after the 90`s wave of FDI, notably Hyundai. Thus, data suggest the existence of a non-cooperative oligopoly: prices vary according to the firm-level scale of production, and market-shares do vary, although not substantially.

Relatively stable market-shares and prices changing according to imports suggest that domestic competition has been weaker than foreign competition. Thus, domestic competition could not be viewed as a perfect substitute for foreign competition (contradicting what some interviewees from the industry claimed). Overall, our quantitative data points that prices are determined by the competition with imports, and thus by the exchange rate, despite the import tariffs of 35%. On the other hand, domestic concentration indexes suggest that domestic competition do exist, although, as said, domestic prices are more affected by import competition. This happens even taking into consideration that most of the imports are made by automakers with domestic production. One potential explanation is that domestic competition is more by product, while competition against imports is what limits domestic price.

As accounted for in the interviews, Chinese were disruptive in terms of price, especially around 2009-2012. Inovar-Auto seems to have had an impact in reducing this Chinese competition, but the exchange rates were the responsible for the overall change in imports. Therefore, we can say that the main impact of Inovar Auto was to reduce foreign competition from automakers without a production presence in Brazil, and therefore supporting domestic prices (reverting, helped by the Brazilian currency appreciation, the price downward trend that started around 2005).

Nonetheless, qualitative evidence indicate that foreign competition tends to affect more intensely firms in high value-added sectors, while domestic competition is relatively more important for lower tech and smaller firms.

Furthermore, the measures on prices and on TFP and the R&D and innovation data analysed in this thesis suggests that other sources of entry and exit barriers besides trade protection are also contributing to deter productivity and innovation.

Regarding the effects on firms' effort to improve productivity (the so-called x-efficiency), interviews pointed to a mixed situation: while the high levels of protection indeed reduce competition from imports, the high domestic production costs ("custo-Brazil") and the domestic competition does not allow for high mark-up levels. However, for smaller firms, besides the domestic competition pressure, there is also pressure from domestic oligopolized suppliers and buyers. The result is a very volatile mark-up for the bigger firms (arguably fluctuating according to the business cycle of the Brazilian economy and the movements of exchange rates that increase or decrease foreign competition), and a more squeezed mark-up for smaller firms (although they also fluctuate through the business cycle).

If the “inverted U” relationship between competition and innovation effort, discussed in this thesis, were to hold, the intermediary level of competition depicted here would imply relatively high levels of innovation effort. However, as suggested in this research, it seems that business environment aspects not related to competition (such as interest rates, access to technology, quality of judicial system etc) may play a bigger role in defining risk-taking and overall investment patterns, including innovation efforts.

2.c Channels linking trade policy and competitiveness: access to technology and imported inputs

Besides effects related to scale, trade protection can raise production costs because of (i) lower access to cheaper imported inputs; (ii) because of lower firm-level productivity of domestic firms, allowed to survive under protection; and (iii) because of overall lower scale of production throughout all value chains.

Moreover, technology is viewed as a factor that makes protection even riskier, as the technological frontier is moving faster and any step disconnecting the domestic market from this frontier could led to a much more difficult catch-up in the future. The interviews suggest that a faster pace of technology can make harder for industries that are not connected to the technological frontier to follow through.

Developing countries are competing for “failing” industries, with ever lower value-added, while developed countries are competing for the “frontier” industries, with much higher value-added. On the other hand, Rodrik (2015) suggests that the reduction of protection left developing countries exposed and led them into premature deindustrialization. The question is then how to promote a faster catch-up in a world with a faster technology growth. The literature suggests that it depends on where the main source of technology is: domestic or foreign.

As stated by interviews, multinationals – automakers and most tier-1 suppliers – face no problem to access better and cheaper foreign technology apart from a relatively small extra cost. Moreover, some high technology imported inputs would be always imported, given the required scale to produce them domestically. However, smaller autopart producers do face restrictions in access foreign technology, and, for them, lower tariffs for high technology inputs would be even more important, as it would not only be an advantage in terms of costs, but also in terms of technology adoption.

The data from the Brazilian automotive sector shows that the nominal protection for autoparts is the second highest among all sectors in Brazil, but instead of causing a less protected final good (vehicles), what we see is that vehicles are even more protected, depicting the highest effective protection among all economic sectors in the country. Thus, the Brazilian automotive sector shows an equilibrium with high effective protection for both final goods and its inputs. The result is a higher price than it would prevail at world prices, both because of lower foreign competition for autoparts and higher costs (autoparts for vehicles) and because of lower foreign competition for final goods.

It was disputed if tariffs are high, after all available mechanisms to reduce it. As stated, the tariff mode for autoparts is 16% and the average is 14%, but if there is no domestic production the tariff is either 0% or 2%, thanks to the "ex-tarifario" regime. The caveat is that the regime is bureaucratic and costly to be accessed by smaller firms (interested firms need to ask for the inclusion of the required imported good in the list of "ex-tarifario"). Moreover, the system also does not work properly when a domestic firm produces a "similar" good of inferior quality and thus hinder the tariff reduction. Thus, the high transaction costs to claim special regimes suggest that access to foreign inputs is a bigger problem for the smaller and lower tier firms, as confirmed by interviews. Moreover, it was suggested that tariffs on the import of specialized services are increasingly becoming a threat to domestic competitiveness.

Within the Brazilian Automotive Industry, automakers and tier 1 autoparts have the knowledge and the ability to use (as they are mainly multinationals), but not always access in terms of costs (especially for higher technological content, as pointed in our interviews), and no incentive to fully apply it. The costs would be reduced if tariffs are decreased and if there is enough purchase scale. The willingness to apply it would depend on competition, or regulation (as accepted by all types of interviewees, with different "nuances"). For smaller firms, like many autopart producers, there is no knowledge, ability, access, or incentive to use higher technologies.

Taking the aircraft maker Embraer as an illustrative comparison, a cost reduction of around 10% (resulting from zero import tariffs, 50% less interest rates, and 30% less freight costs, in our cost-structure simulation) would not explain its success in exporting. According to the interview, despite important cost advantages, the main reason for Embraer's success was the access to technology and its use. By "access", we mean the combination of (i) knowledge; (ii) ability to use; (iii) accessible cost; and (iv) incentive to apply.

Nonetheless, a reduction in the costs of inputs and an improvement in the business environment, as depicted in chapter 6, could directly reduce total costs in around 10%. This, together with a potential extra reduction of taxes embedded in the production value chain – and that allegedly are not properly compensated before the vehicle is exported – could represent a cost reduction of nearly 20%. As the industry operates in an imperfect competition, the impact on final prices would be probably less, but even a 15% decrease in final prices would mean a significant competitiveness gain for Brazilian vehicles. All this independently of the dynamic benefits arriving from the technology incorporated in better imported inputs, as this is not measured in our chapter 6.

Interviews also pointed that, although the importance of a domestic supply base is diminishing, there is a percentage of supplies that need to be sourced domestically, both because of costs and strategic considerations. Still according to some responses, this domestic base would exist even under free trade.

The overall conclusion is that access to foreign technology and to foreign scale through the access to imported inputs is an ever-increasing advantage to catching up and to increase competitiveness of one`s own industrial sector.

3. Business environment

Import tariffs and business environment seem to have a similar (in value) contribution to total costs, either for automakers or for autopart producers. The maximum direct cost reductions that would be possible with a zero-import tariff for inputs would be around 6%, for automakers and autopart producers alike. On the other hand, the maximum direct cost reductions that would be possible with a zero interest rates (a proxy for the ceiling in terms of business environment improvement) would be around 5,6% for automakers and 4,5% for autopart producers.

As said before, these cost reductions are only the direct ones. Such changes in tariffs and interest rates would affect the entire supply chain, thus potentially increasing the effect of cost reductions. Moreover, although we used interest rates as a proxy, there is scope for further improvements in the business environment affecting the cost of freight. Those values, seem similarly important in comparison to potential exchange rate variations: although Brazilian exchange rates can vary by far more than 6%, the net effect on competitiveness is always lower than the exchange rate variation itself, as it changes the costs for both the final goods and the inputs.

Moreover, these two factors are mutually interlinked: Overall, lower levels of trade protection would provide the necessary push to move these agenda on business environment, and, on the other hand, a better business environment can shape dynamic comparative advantages, working together with the structure of protection.

According to some interviewees, with a better business environment tariffs could be reduced to zero. The bad business environment causes not only higher production costs, but also disincentivises innovation and the adoption of technology. However, firms may not be interested in improving the business environment if it serves as an entry barrier in the domestic market and if protection gives them what they need to survive competition from abroad. An alternative explanation for this lack of effort to improve the business environment is just the lack of organization, generated by a lack of long-term vision.

Moreover, recent empirical literature has demonstrated that better institutions and business environment – that are able to generate more efficient and safer contracts – can promote the growth of more contract-intense and complex activities, potentially changing a country comparative advantage.

4. Implications of new technologies and changes in industrial policymaking

In the current paradigm we have automakers buying autoparts from suppliers and selling vehicles to consumers. However, this paradigm is likely to change to a market where automakers could become providers of transport services, instead of selling products. Moreover, industry 4.0 technologies have the potential to drastically alter the geography of investment and production worldwide as countries without access to it risk losing competitiveness at a faster pace. Labour costs are losing importance and thus traditional industrial policy focusing on subsidies for production costs in general are becoming less effective. Current competitiveness in some parts of the value chain does not guarantee a future competitiveness, as technologies can change the entire composition of the value chain. Therefore, constant innovation is needed.

Institutions shape the business environment and the structure of protection in parallel, and the business environment and the structure of protection seems to have mutual effects upon each other. In a world with cheaper and easier transport of goods, and where most value added is not on assembly anymore, the mere competitive advantage on labour or capital is not the main source of overall competitiveness. In this sense, the business environment and institutions could be more important to shape comparative advantages than traditional availability of capital or labour. This view is already presented in the literature, and it seems confirmed by most of our interviews.

Another aspect with the potential to dictate the future of the automotive sector in Brazil is the possibility of entering the global stage in electrical vehicle production. There is already a small market for EV vehicles in Brazil, essentially filled by imported vehicles. Interviews in this thesis suggested a potential competitiveness advantage in hybrids with ethanol. Whatever the technology chosen, it is clear that petrol or diesel engines will no longer be used in the near future. This, together with the trend of automobiles being seen as a service, and not as a consumer good anymore[158], will drastically change the conditions for having a competitive and value-adding domestic industrial base. In turn, industrial and trade policies need to change accordingly. And the need for a better business environment, better infrastructure (electricity and telecommunications) and more scale, is even more important.

Participation in global value chains can indeed deliver higher competitiveness but is not a panacea and needs to be seen against some potential risks. Perhaps the biggest counterargument is the need to consider the resilience risks of such chains, as demonstrated, for example, by the Fukushima disaster in March 2011, when several automakers faced supply disruptions of parts and inputs imported from Japan. This caveat with regard to global value chains can also be a reason for some "reshoring" – the movement to relocate production sites back to the company's original home country. But it is not only the risks of supply disruptions that are potentially limiting the attractiveness of global value chains: the rapid technological transformation seen in manufacturing plants, as a result of industry 4.0 technologies, can make manpower a much less important factor in the cost structure. This means that the main attractiveness of some developing countries – cheap labour – is losing importance as a competitiveness determinant, thus leading also to a potential reshoring. But there will still be reasons to justify foreign direct investment: the proximity to consumers (linked to domestic market size) and tax benefits being the most cited among interviewees. However, these factors need to be balanced against several others, such as domestic access to skilled labour (linked to digital literacy), infrastructure

[158] Meaning that increasingly cars will be owned collectively (e.g. in car pools where people simply make an initial contribution and then hire them for a small fee) rather than being purchased by individual consumers.

(mainly telecommunications), an overall better business environment and lower institutional risks, and even natural disaster risks.

As seen in this thesis, regional value chains, as an alternative to global value chains, can also be seen as a potential source of competitiveness, while the expansion of regional trade agreements can provide a safer path to trade liberalization from the perspectives of developing countries. But for these to be part of viable long-term developing strategy there is the need of allowing true competition to take place.

The overall implication from all the previous paragraphs, for a middle-income developing country with a reasonable industrial base, such as Brazil, is that industrial policies should actively promote the use of the best technology in a widespread way. Single-sector approaches may not be enough, as the entire value chain needs to be connected and engaging with industry 4.0 technologies. Trade policies need to be seen as part of the strategy, allowing the access to foreign technology, and not contributing to the maintenance of firms or sectors that are not competitive without high levels of tariff protection. Moreover, as in all public policies, any given subsidy needs to be well designed, targeted to solve a clearly identified problem in a transparent way, and time-limited to avoid misuse. The evidence provided in this thesis exemplifies the costs of lacking these basic conditions, and thus confirms the need for them.

The spread of new technologies that allow a firm to tap services provided by suppliers all around the world, together with the availability of funds to finance promising startups, makes it possible for small initiatives to rapidly create not only new goods and services, but also entire sectors. Technologies allowing for a smart factory - such as the ones presented in the concept of Industry 4.0 - can provide a form of leapfrogging (a way to skip traditional processes or technologies to arrive at the technological frontier). As noted by Lee et al (2019), based on ILO (2016), developing countries still relying on mass production (industry 2.0) could potentially jump to industry 4.0 production (smart factories) without the need to invest in industry 3.0 (automation) production. Combining these views with the one that value-added is not in traditional manufacturing anymore, there is a clear indication that developing countries with enough human capital should promote innovation and technology adoption, and those without enough human capital should improve on it, instead of promoting protectionist policies that build white elephant projects with short-lived jobs. Moreover, the coordination role of Governments is important, both to make sure that information flows unimpeded and to foster the necessary Information Technology infrastructure, such as 5G.

The caveat is that Industry 4.0 technologies can also increase the distance between the technological frontier and the less advanced countries, as developed countries are, arguably, better prepared to make full use of those technologies.

Thailand and Malaysia are identified by Lee et al (2019) as examples of the middle-income trap, a group into which we can easily put Brazil. Their emphasis on the need for better education and training to increase adoption capabilities is then complemented by our emphasis on a renewed need for a better business environment. Going even further, based on the findings of this thesis, we believe that factors such as the safety and overall quality of life of cities and countries will become increasingly important in defining the physical locations of (home) offices for high-skilled and mobile labour. Regarding business headquarter and R&D facilities` location, we see the primary role of a good business environment and institutions. Taking these two aspects into consideration, the future may be bright for places already leading the tables, while developing countries need to invest now, and strongly, to both improve the business environment, fostering both the adoption of industry 4.0 technologies and the creation of innovative business, and also to improve the overall quality of life and safety of their population. These will be the factors behind success or failure in the decades to come.

Industrial policy can be potentially beneficial, if implemented with care, with more horizontal and pro-competitive policies, and with minimum distortions and rent-seeking behaviours. As part of the literature believes this is impossible, they simply rule out industrial policies as a whole, arguing that the risks far outreach the potential benefits (that would be the development of more productive sectors and firms, with more innovation and income generated domestically). However, interviews favoured a more "horizontal" type of industrial policy, based on clusters and partnerships with the Government to identify bottlenecks, and setting standards for final goods, to promote competitiveness, exports, and internationalization of firms. The standard-setting type of regulation is viewed as needed to promote technology adoption but bounded by the limited income levels of domestic demand.

Inequality is also a problem for upgrading. The Brazilian inequality negatively affects competitiveness both because it restricts access to education and thus the supply of skilled labour and because it reduces demand, making the domestic market smaller than otherwise. In other words, with a better income distribution the domestic demand could be higher, and more in line with what would be expected from a country with such population. Another implication of a demand composed mainly by lower-income individuals is that, without the access to cheaper imported vehicles, domestic consumption pattern will be characterized by lower quality and less innovation.

Sectoral industrial policies and incentives for R&D are then seen as secondary factors: they can be important and helpful, but without addressing the main problems related to business environment, industrial policies and incentives, may have very low effectiveness. However, among the types of industrial policies and incentives the most effective strategy is the one that generate public goods, scale, and coordination, setting guidelines and regulations to allow firms to plan years ahead. Thus, examples of suggested policies would be: promotion of more traditional clusters; more R&D partnerships with research institutions; interactions between the government and the private sector to identify and solve bottlenecks, in a transparent way; discussion and elaboration of consensus legislation and regulation as state policies, instead of governmental policies. Moreover, attention is needed for the smaller firms that are somehow out of the current system of support and incentives. As these firms lack the representative power that bigger firms have, it would be important to set up special channels for these smaller firms to access and to be contacted by the Government.

Regarding R&D incentives, the overall opinion is that there are reasonably good instruments in place, being two of them explicitly mentioned by several respondents: "lei do bem" and Embrapii. Part of those who praised the current system of R&D incentives also said that sectoral industrial policies for R&D are unnecessary and even counterproductive.

However, R&D activities are becoming more concentrated in global centers, and Brazil is not – and probably will not be - among these centers, in the near future.

Automakers in Brazil are mostly multinationals, with full access to innovation from headquarters, but still enjoying very high effective protection against import competition. Meanwhile, domestic autopart producers face more obstacles from "custo-Brazil", as they have less access to foreign technology, to cheaper funds, and have less scale to deal with the high fixed costs brought by the bad business environment. Inovar-Auto is an example of ill-conceived policy, as it lacks the proper identification of the market-failure that could justify such a policy, and, therefore lacks a clear objective. Some interviewees` claims resembled infant industry arguments, although automakers, at least, are clearly not an infant industry in Brazil. As noted in this research, protectionist strategies, such as local content requirements or tariff barriers, may have helped the industrialization process up to the 1980s, but at an unknown cost and, more importantly, in a context that does not exist anymore.

There is no evidence, either from our interviews or from our quantitative results, that Inovar-Auto promoted any increase in innovation. The TFP measures are still too short in time (2018) to consistently capture longer terms potential effects from Inovar-Auto (2012-2017), but the behaviour of TFP indicates that it did not change for any reason apart from changes in scale.

Overall, the responses pointed that the technological gap is increasing in the last decades, for most respondents, from al groups, but there are some exceptions. As an example, there are improvements in energy efficiency - arguably improved by Inovar-Auto, according to one government source and two automakers. However, most answers depicted Inovar-auto as a bad policy and pointed that this policy did not contribute to reverse the aforementioned increasing technological gap: it generated costs and did not promote innovation.

Moreover, some investment decisions made during the years under Inovar-Auto would be done independently from Inovar-Auto. This is in line with the literature, as it points that industrial policies are only the "cherry on the cake", as forecasted demand is the real driver for investment. In Brazil, interviews suggest that the smaller BMW, Mercedes and Audi plants are the ones who potentially came only because of the protectionist policy, in order to bypass the increased tariff. However, their production is quite low in Brazil, and they rely on much more foreign inputs than the average Brazilian automaker.

Regarding the effects on scale, during Inovar-Auto, total production rose during the period, as also the number of domestic producers. The average scale per producer, a result from these two previous measures, showed an oscillated behaviour. In the qualitative chapter there was the argument that although new entrants may have increased domestic competition, these new entrants also contributed to reduce average scale vis a vis what would be observed without them. However, if we discard the niche operations, that in Brazil would include the Ford brand Troller, with their low scale fiberglass light commercials (as explicitly mentioned in our interviews) and producers such as BMW, who have basically a CKD small operation, there was no significant average scale reduction.

As a final note, Inovar-Auto did stop the rising import trend of vehicles, but this result was achieved in combination with exchange rate movements as well.

5. Overall conclusions

In the previous century, total protection indeed allowed the creation of Brazilian Automotive Industry. Absolute protection given to the Industry lasted until the trade liberalization of late 80s/early 90s, in a similar way verified in most of the manufacturing sectors in Brazil. However, the duration was probably too long, in accordance with the prevision of the theories about lobby and the critics of the infant industry argument. Moreover, increasing technological developments tend to make the social costs of protection higher than before, as protectionist policies risk to make catching up less likely. This is confirmed by our interviews, who stated that few big firms dominate specific technologies around the world. The Brazilian experience did not have either export targets neither an earlier protection reduction, conjugated with a better business environment, or even with a more specialized economy (horizontally or vertically).

Moreover, the domestic competition was not a substitute for this foreign competition, as could be seen from our data, for the automotive sector.

Currently, inefficiencies in Brazilian auto production are mostly found outside the factories, while within their plants the multinational automakers and first-tier suppliers are themselves efficient in terms of their own production. Our results suggest, as a potential path for increased competitiveness, more specialization, a better business environment, and a lower structure of protection (mainly allowing for cheaper access to high tech inputs).

However, the import of inputs is not a sufficient condition to gain the required competitiveness. More input imports would generate more competitiveness and then more exports only in the long-term, as it takes time either to make better use of the imported inputs (given complementarity issues, learning by doing etc) and it takes time to open up export markets. Moreover, only imported inputs that aggregate a better technology can have the dynamic effects of improving competitiveness through technology adoption. If the imported input brings only a cost-advantage, the effect in competitiveness is more limited and tend to be short-lived. A more important condition is the improvement of the business environment: the direct impact is as important than the direct impact of cheaper inputs, but with better institutions, infrastructure and capacity to adopt new technologies there is the potential for not only more technology adoption (as is also the case of accessing foreign inputs), but also for more investments and innovation. The import of inputs, without the improvement of the business environment does not disseminate the technology into the economy, and only promotes the specific change of the domestic input by the imported one. Thus, the potential social benefit is almost entirely lost, as the final goods maybe does not gain competitiveness and then scale. In other words, it could be not sufficient to trigger a virtuous cycle. Only real “maquiladoras”, or export processing zones, would export more using more imported inputs despite a bad business environment. Moreover, lower protection to the final goods is needed, in order to do not attract the wrong type of FDI.

It is possible to group Brazilian industries into four main types: (i) firms that use almost only domestic inputs, and do not trade because they do not have the quality or the interest to export. Usually they are in the low technology sectors; (ii) firms that rely heavily on imported inputs, with very limited domestic value added. This is not a guarantee for their competitiveness, though, as they still can face huge constraints given the bad business environment (especially if they pay a lot for their inputs, and their logistics represent an important part of their costs, for example, or if they rely heavily on financing and do not have access to subsidized loans or foreign loans, or if they are not hedged against currency fluctuations). Some of these firms and sectors only exist because of trade protection (final goods); (iii) industries that have a reasonable domestic value added and that can choose to export more or less, such as the automotive industry; (iv) industries that rely heavily on imported inputs and export a lot, such as Embraer. Usually, on the high-technology sectors. An important note to make here is that, although Embraer relies heavily on imported inputs, there is an important value added in the design and R&D made by the firm in Brazil.

Automakers have plants distributed around the world with different scales, but R&D is concentrated in developed countries, where these multinationals usually come from. Although in the last decade we saw an intensification in the transferring of production from developed countries towards large developing countries, the overall picture is of excess capacity worldwide. Interviews and data confirmed the most important factors for investment decisions within the automotive sector: existence of potential for scale (mainly from the domestic market and trade agreements); the availability of good suppliers and technical expertise; productivity and production costs; the overall structure of protection; and the overall business environment. As industry 4.0 technologies evolve, investment costs and optimal scale tend to be reduced, thus potentially intensifying the speed of changes in production location. Moreover, the existence of a domestic supply base is also losing importance, as the existence of global vehicle-model platforms allow for the concentration of suppliers at the world level, with increasing scale. In this fast-evolving scenario, technology can be developed or adopted more easily, where there is a better business environment.

Interviews confirmed the literature in that scale of production can be promoted by a higher access to imported inputs (potentially produced at higher scale abroad); by more exports; and by specialization. Interviews also suggested that a faster technological progress reduce the scope for trade protection, as it increases the risks of lagging behind. This is not to say industrial policy should not use any tariffs, but responses pointed that other measures are less risky and potentially more effective. These can be seen collectively as improvements in the business environment.

The empirical evidence gathered in the literature suggest that the new technologies are shifting value added from manufacturing to specialized services, and that the frontier between different sectors is becoming less clear. These two aspects, conjugated with the fact that technology evolves increasingly faster and knowledge and information are the key assets, leads to the conclusion that horizontal industrial policies that improve the business environment, education, and that promote basic R&D, together with integration into world markets, are the way forward. However, this menu should not be applied in the same way for all countries, as the development stage and the endowments should be taken into consideration, before deciding the degree of trade integration (structure and dynamics of trade protection).

There is a need for horizontal more than vertical industrial policies, partly to improve the business environment. Industrial policy can aim to create new comparative advantages, and this indeed can be better than accepting the present comparative advantages, but, to do this, they need to enhance the chances of self-discovery (business environment), promote chain competitiveness (specialization and not total protection), and, if targeting a sector, be sure to limit protection (in level and in time), and to foster either domestic competition or exports. It should promote “activities”, in a broader sense, with no discrimination and no entry or exit barriers. Moreover, cooperation for R&D etc with the government and research centres is a must.

The scope for a more direct and sectoral policy intervention is for cases where there are unequivocal and enough positive externalities. Among these, reason for intervention that is growing in importance for economies based on network scale, are coordination problems, such as for example the provision of infrastructure for electrical cars. In this case, regulation may not be enough, and some initial subsidies or public policy regarding charging stations, for example, may be needed to induce further investments.

Contrasting the automotive sector with Embraer, it was said that the aeronautical sector is less affected by the business environment (it does not have to face the same transport infrastructure problems, and it benefits from lower taxation, as an exporter) and it can import inputs in an easier way. As such, the interview with Embraer does indicates that being less affected by the business environment is a competitive advantage, but it does not provide evidence of its prominence relatively to the easier access to foreign inputs, for example. Moreover, the interviewee related that Embraer is heavily exposed to foreign markets, being under intense competition and relying on a worldwide scale of production of its parts and for its final demand. This is thus a confirmation of the previous statements that the most important determinants for industrial competitiveness for Brazilian firms would be the business environment and scale of production (both for its final goods and for its inputs, what is another way to view the importance of accessing better and cheaper imported inputs). No single channels stand out alone. Rather, is the sum of those, and their interaction effects, that make them crucial to a development strategy. Each variable can contribute to vicious or a virtuous cycle, compounding the problems or the solutions. Our research confirmed that these variables are mainly within three umbrellas: the business environment, the structure of protection, and the relative low specialization and scale. The former has a potentially greater importance in more technologically advanced industries, and the two later ones are strongly related, <u>as more protection seems to have induced less specialization.</u>

There is a need for gradual reduction of protection, but not necessarily its complete removal. Moreover, there should be attention to the fact that tariffs reductions concentrated into autoparts and components could make effective protection for automakers even higher. Therefore, tariffs should be necessarily reduced also for final goods (cars), and in a way to do not increase effective protection. Moreover, the strategy of the transition is key: a too fast liberalization without a proper improvement in the business environment would potentially generate too much unemployment and transition costs.

The protection enjoyed by the Brazilian firms, together with a focus on the domestic market, instead of exports, makes international competitiveness a less appealing target by these firms. Firms prefer to ask for individual gains than to contribute to improve the business environment, in a low-level Nash equilibrium. This, for instance, reduces the incentives for a coordinated effort to tackle the deficiencies of the domestic business environment. Given that, the bad business environment – or "Custo-Brasil" is higher than otherwise. As this higher "Custo-Brasil" implies the need of higher protection to keep domestic firms afloat, we have a vicious circle. In other words, the business environment in Brazil substantially damages competitiveness of the manufacturing sector and give political excuses for a higher protectionist environment. Conversely, the higher protectionist environment reduces the incentives for the dominant domestic manufactures to call for a better business environment. The result is that the high protection levels against imports help to shape a worse business environment equilibrium.

The research also highlighted the importance of high interest rates as a major deterrent of industrial competitiveness in Brazil, both by direct (higher costs of funds) and indirect (a more appreciated domestic currency) channels. The evidence gathered in this research also allows us to infer – although we did not quantitatively compare these – that the strong recent structural reduction in interest rates faced by the Brazilian economy has the potential to deliver positive competitiveness results that are more important than the industrial or trade policies seen up to now. Thus, the fiscal and macroeconomic changes that allowed substantially lower interest rates in Brazil seems to have the potential to improve industrial competitiveness to levels not seen before. However, although important, the reduction in interest rates is not enough to make the Brazilian economy ready to enter the centre stage of global competition and innovation. It is also necessary to be completely immersed into Industry 4.0 technologies. For this, the reduction of other aspects of "custo-Brazil" are increasingly important. Moreover, as said before, the urgency to move to more technology-intensive sectors and processes is growing, as the competitiveness advantages from cheaper labour are losing importance. This last aspect is also added by the well-documented fact that value added is increasingly coming from activities intense in ideas, innovation and creativeness, while the manufacturing process itself is losing space in value-adding.

The recent EU-Mercosur Trade Agreement, aimed to reduce trade tariffs on a phased timetable, makes it all the more urgent to address the issues discussed in this thesis.

The agreement, concluded on June 28th, 2019, covers tariffs on goods and services, technical and sanitary barriers and measures, intellectual property, government procurement and other issues. The EU exports are concentrated in machinery, chemicals, pharmaceuticals, cars and car parts. Moreover, these sectors are heavily protected by tariffs, what suggest that a reduction in those tariffs could be very worrying for the Brazilian firms in these sectors. As seen in this thesis, cars, for example, are protected by 35% tariff on imports.

However, we can argue that the structural reduction of interest rates in Brazil (and the consequent currency depreciation) has the potential to make the country much better prepared to compete with European manufacturers based on current manufacturing practices. Nonetheless, to compete in the smart-factory world of industry 4.0 technologies the threshold is higher, and competitiveness will likely be given by first-mover advantages from tapping into the new reality and opportunities, within existing sectors, and to new ones.

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APPENDIX FROM CHAPTER 6

APPENDIX I – BRAZILIAN MARKET STRUCTURE

Domestic production - automaker operations in Brazil - cars and light commercials (1975-1993)

Automaker	Start of production in Brazil	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Ford	1957	155.880	156.312	110.301	138.623	148.439	140.565	110.245	133.734	157.657	169.127	175.255	169.963	115.011	157.868	160.736	135.439	141.523	146.680	203.603
GM	1957	159.461	167.914	130.688	183.299	196.010	217.208	147.511	176.733	205.372	194.283	217.203	244.184	188.045	238.080	234.195	199.679	193.076	211.606	272.614
Volkswagen	1957	502.580	529.636	472.192	518.603	525.703	514.237	295.303	324.142	341.354	302.697	345.982	372.691	309.179	361.993	315.589	280.686	287.315	344.268	451.793
Fiat-Chrysler (FCA)	1976	0	8.350	65.052	97.302	129.321	160.217	130.381	163.449	146.213	138.207	150.981	167.389	213.647	213.649	217.829	223.668	255.556	310.272	393.591
Toyota	1959	895	1.498	2.695	3.669	4.105	4.310	4.070	2.706	2.500	3.290	2.585	3.493	3.696	5.007	5.020	5.091	6.696	3.053	2.627
Honda	1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mitsubishi and Suzuki (MMC/HPE)*	1998 (2013)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renault	1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercedes-Benz**	1999 (2016)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peugeot-Citroen	2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nissan	2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyundai-Subaru (CAOA)	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyundai	2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BMW	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Audi	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cherry (CAOA Cherry since 2017)	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jaguar-LandRover	2016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total production in Brazil		818.816	863.710	780.928	941.496	1.003.578	1.036.537	687.510	800.764	853.096	807.604	892.006	957.720	829.578	976.597	933.369	844.563	884.166	1.015.879	1.324.228

* Suzuki models manufactured at the plant: year 2015: 2251; year 2016:1503; year 2017:2033; year 2018:2207. No data available for 2013 and 2014.

** Since 2016 it produces the class C and the GLA. Anfavea production data for this Mercedes plant is not available. Instead, we use data for registration of nationally manufactured vehicles for these years.

These numbers can be sligthly smaller than the production figures because they do not account for any vehicle eventually exported, for example.

*** It does not include proving grounds, distribution centers and plants producing solely trucks, buses or agricultural machines.

****Sharing a manufacturing unit with Nissan.

Sources: Anuario Anfavea 2019 and Abeifa (http://www.abeifa.com.br/Mercado)

Domestic production - automaker operations in Brazil - cars and light commercials (1994-2018)

Automaker	Start of production in Brazil	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ford	1957	209.970	144.832	137.321	213.276	171.164	98.397	107.866	105.940	144.763	203.734	256.483	302.012	298.855	286.117	294.794	322.226	318.369	286.357	286.325	333.124	246.397	227.749	209.570	248.061	267.758
GM	1957	286.832	342.236	442.815	505.100	412.304	333.965	438.892	509.411	517.167	511.517	562.012	561.449	550.185	576.952	603.819	598.773	651.051	650.846	615.550	680.737	582.599	361.779	334.447	474.026	466.445
Volkswagen	1957	498.543	582.398	615.276	642.233	478.376	377.589	490.871	518.026	493.966	441.197	646.371	693.324	731.967	796.961	848.889	857.549	1.067.105	828.444	852.086	761.193	596.502	422.530	324.886	408.339	433.466
Fiat-Chrysler (FCA)	1976	500.738	463.669	539.658	619.166	414.074	399.803	433.693	436.218	386.160	357.971	436.605	503.105	562.531	717.836	722.450	736.620	757.418	762.181	820.041	756.717	675.396	485.288	376.262	494.181	497.168
Toyota	1959	3.734	3.731	3.203	3.791	5.064	11.538	18.809	14.649	17.426	40.953	53.131	57.356	57.991	55.974	66.983	62.713	64.588	60.456	66.332	129.653	160.541	170.569	177.037	197.970	209.384
Honda	1997	0	0	0	837	15.775	17.957	20.568	22.058	20.564	33.927	56.544	65.527	78.962	106.027	131.139	132.122	131.455	85.545	135.058	135.065	127.232	148.074	120.585	134.813	137.983
Mitsubishi and Suzuki (MMC/HPE)*	1998 (2013)	0	0	0	0	652	3.098	6.252	8.571	9.743	11.767	18.011	20.153	20.171	25.844	37.203	32.429	37.558	39.441	37.353	43.101	45.772	29.397	19.573	18.781	22.363
Renault	1999	0	0	0	0	0	24.809	58.083	71.108	48.040	58.606	66.645	60.507	65.604	97.458	122.160	121.529	172.455	220.625	253.425	282.595	219.475	175.459	204.889	245.784	291.346
Mercedes-Benz**	1999 (2016)	0	0	0	0	0	14.307	15.682	10.796	8.168	6.989	5.560	3.655	0	8.349	27.095	15.211	12.260	0	0	0	0	0	3.072	7.632	7.620
Peugeot-Citroen	2001	0	0	0	0	0	0	0	18.116	49.107	46.114	68.648	98.902	95.686	119.439	130.975	117.289	149.472	147.185	99.518	143.634	91.296	69.712	84.524	95.713	77.636
Nissan	2002	0	0	0	0	0	0	0	0	3.744	8.025	10.196	10.306	8.661	9.111	5.316	18.908	18.155	32.640	31.342	26.809	32.688	47.061	43.753	81.764	104.317
Hyundai-Subaru (CAOA)	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	2.983	11.268	6.814	24.777	38.635	25.568	35.117	35.558	33.739	19.145	21.388	14.792
Hyundai	2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.003	166.269	173.843	165.934	161.756	182.319	191.646
BMW	2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	518	10.216	8.666	7.978	8.563
Audi	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	503	6.216	6.588	4.942
Cherry (CAOA Cherry since 2017)	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.380	1.401	3.704	8.634
Jaguar-LandRover	2016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	746	4.658	4.295
Total production in Brazil		1.499.817	1.536.866	1.738.273	1.984.403	1.497.409	1.281.463	1.590.716	1.714.893	1.698.848	1.720.800	2.180.206	2.376.296	2.470.613	2.803.051	3.002.091	3.022.183	3.404.663	3.152.355	3.248.601	3.494.014	2.987.817	2.349.390	2.096.528	2.633.699	2.748.358

* Suzuki models manufactured at the plant: year 2015: 2251; year 2016:1503; year 2017:2033; year 2018:2207. No data available for 2013 and 2014.

** Since 2016 it produces the class C and the GLA. Anfavea production data for this Mercedes plant is not available. Instead, we use data for registration of nationally manufactured vehicles for these years.

These numbers can be sligthly smaller than the production figures because they do not account for any vehicle eventually exported, for example.

*** It does not include proving grounds, distribution centers and plants producing solely trucks, buses or agricultural machines.

****Sharing a manufacturing unit with Nissan.

Sources: Anuario Anfavea 2019 and Abeifa (http://www.abeifa.com.br/Mercado)

IPCA Historical series - accumulated annual changes (%).			
Date	Annual inflation (IPCA) - all items	Annual inflation (IPCA) - new cars	Annual inflation (IPCA) - autoparts
December 1980	99,25		
December 1981	95,62		
December 1982	104,79		
December 1983	164,01		
December 1984	215,26		
December 1985	242,23		
December 1986	79,66		
December 1987	363,41		
December 1988	980,21		
December 1989	1972,91		
December 1990	1620,97	1406,34	1217,86
December 1991	472,7	513,38	520,52
December 1992	1119,1	995,32	972,32
December 1993	2477,15	2293,43	2566,84
December 1994	916,46	774,98	741,48
December 1995	22,41	7,45	22,96
December 1996	9,56	8,6	8,87
December 1997	5,22	3,79	4,82
December 1998	1,65	-6,01	-1,22
December 1999	8,94	22,79	16,07
December 2000	5,97	3,94	4,09
December 2001	7,67	2,42	3,5
December 2002	12,53	0,46	7,41
December 2003	9,3	1,02	7,61
December 2004	7,6	13,65	19,5
December 2005	5,69	3,22	3,97
December 2006	3,14	0,93	1,67
December 2007	4,46	1,74	4,53
December 2008	5,9	-2,25	8,52
December 2009	4,31	-3,62	2,25
December 2010	5,91	-1,03	3,66
December 2011	6,5	-2,88	3,13
December 2012	5,84	-5,71	3,67
December 2013	5,91	3,52	4,09
December 2014	6,41	4,62	3,3
December 2015	10,67	4,84	5,88
December 2016	6,29	0,48	2,93
December 2017	2,95	-0,84	0,83
December 2018	3,75	0,95	0,48
Source: Sidra/IBGE - Índice Nacional de Preços ao Consumidor Amplo (IPCA)			

Note for calculation of real car price variation:

(1+real change)=((1+nominal change)/(1+inflation)))

Import Penetration					
Year	Total production of cars and light commercials, in units (A)	Registration of imported new cars and light commercials, in units (B)	Exports of cars and light commercials, in units (C)	Apparent consumption (D = A+B-C)	Import penetration coefficient (E = B/D)
1975	818.816		20.236	798.580	0,00%
1976	863.710		14.296	849.414	0,00%
1977	780.928		18.926	762.002	0,00%
1978	941.496		36.925	904.571	0,00%
1979	1.003.578		34.166	969.412	0,00%
1980	1.036.537		63.871	972.666	0,00%
1981	687.510		113.020	574.490	0,00%
1982	800.764		105.474	695.290	0,00%
1983	853.096		100.687	752.409	0,00%
1984	807.604		107.370	700.234	0,00%
1985	892.006		116.596	775.410	0,00%
1986	957.720		86.294	871.426	0,00%
1987	829.578		230.488	599.090	0,00%
1988	976.597		203.035	773.562	0,00%
1989	933.369		181.484	751.885	0,00%
1990	844.563	115	108.960	735.718	0,02%
1991	884.166	19.837	85.586	818.417	2,42%
1992	1.015.879	23.691	158.074	881.496	2,69%
1993	1.324.228	69.078	97.517	1.295.789	5,33%
1994	1.499.817	184.358	99.553	1.584.622	11,63%
1995	1.536.866	364.748	81.671	1.819.943	20,04%
1996	1.738.273	219.515	103.110	1.854.678	11,84%
1997	1.984.403	299.818	191.327	2.092.894	14,33%
1998	1.497.409	343.833	224.201	1.617.041	21,26%
1999	1.281.463	174.974	195.682	1.260.755	13,88%
2000	1.590.716	166.348	272.529	1.484.535	11,21%
2001	1.714.893	175.139	236.380	1.653.652	10,59%
2002	1.698.848	113.134	255.058	1.556.924	7,27%
2003	1.720.800	72.199	374.450	1.418.549	5,09%
2004	2.180.206	59.634	533.244	1.706.596	3,49%
2005	2.376.296	85.214	677.624	1.783.886	4,78%
2006	2.470.613	139.185	588.517	2.021.281	6,89%
2007	2.803.051	273.673	585.645	2.491.079	10,99%
2008	3.002.091	371.077	524.034	2.849.134	13,02%
2009	3.022.183	485.679	351.644	3.156.218	15,39%
2010	3.404.663	657.616	472.370	3.589.909	18,32%
2011	3.152.355	853.962	518.572	3.487.745	24,48%
2012	3.248.601	783.674	411.655	3.620.620	21,64%
2013	3.494.014	703.473	531.627	3.665.860	19,19%
2014	2.987.817	614.941	309.874	3.292.884	18,67%
2015	2.349.390	412.899	389.024	2.373.265	17,40%
2016	2.096.528	271.608	485.255	1.882.881	14,43%
2017	2.633.699	242.308	728.739	2.147.268	11,28%
2018	2.748.358	308.566	595.432	2.461.492	12,54%

Primary data sources: Anuario Anfavea and Abeifa.

Calculations of import penetration coefficients by the author

Note the market was oppened to imports in 1990.

APPENDIX II – INTERNATIONAL COMPARISON OF TOYOTA COROLLA PRICES, USING EXCHANGE RATE ADJUSTMENTS, AND TESTING SCALE, SPECIALIZATION, TRADE BARRIERS AND BUSINESS ENVIRONMENT MEASURES AS POTENTIAL EXPLANATORY VARIABLES.

<u>Models, prices and taxes per country</u>

As a general rule, we chose sedan E-170 models, but for the markets these are not produced we chose the most similar, as the hatchback E-180 (usually around 10% more expensive, in markets were both options are available). The engine sizes and trims were also chosen to be the most similar possible. In this sense we chose the cheapest model with automatic gearbox, petrol, and engine size between 1.6 and 1.8. The inclusion of sales taxes; and delivery, processing and handling fees is explained in the notes for each case. No optional accessory is included.

JAPAN

Type: **hatchback**

Model chosen: **Corolla Sport 2019, GX, 1.2 litters turbo, petrol, CVT, 2 wd (E180)**.

Price (including sale tax): **2,138,400**

Accessories: 521,120

Price with accessories: 2,659,500

Source: https://www.tokyo-corolla.com/lineup/corollasport#u20180605132101

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Takaoka Plant - RAV4, Harrier, Auris, Prius, Auris (Corolla hatchback) - **397 thousand units**

Source:

https://newsroom.toyota.co.jp/en/corporate/companyinformation/manufacturing/

Notes: 1) Models in Japan have smaller engines. The chosen model is then representative of the cheapest automatic option; 2) the previous E180 hatchback

(called in Japan "Auris"); 3) Corolla Axio is a smaller version (wheelbase: 2,600mm), derived from previous generations of Corolla, and based on the platform E-160, built to attend policy specifications for the Japanese market. We consider it a different vehicle; therefore, it will not be used as our representative model for Japan. The total production of the plant where the Corolla Axio model is produced (TOYOTA MOTOR EAST JAPAN, INC.) was 493 thousand units produced in r 2017, together with Aqua, Sienta, C-HR, Porte, Spade, JPN TAXI, Comfort and Isis)
Source:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/manufacturing/

TAIWAN
Type: **Sedan**
Model chosen: **2019 Toyota Corolla Altis 1.8 litters, CVT (E170).**
Price: **656,000**
Source: https://www.toyota.com.tw/showroom/ALTIS#/spec

Total production of plants where the model is produced (includes other models as well):
Plant – main models – thousand units produced in 2017:
Kuozui Motors, Ltd - Camry, Corolla, Vios, Yaris – **118 thousand units.**
Source:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/asia.html

Notes: 1) Taiwan produces the sedan version, there called "Corolla Altis" (a name also used in ASEAN countries); 2) The hatchback version of the new platform E210 will be called Corolla "Auris" in Taiwan.

CHINA
Type: **Sedan**
Model chosen: **2019 Toyota Levin (Corolla) 1.8 litters, 185T CVT (E170).**
MRSP price: **119,800.00 Yuans (11.78 MILLION YUANS)**

Notes on taxes:

The VAT of 17% and the consumption tax of 5% are already included on the MRSP price. The vehicle purchasing tax (VPT) is calculated based on the purchase price excluding VAT. The consumption tax (CT) is also calculated based on the purchase price excluding VAT.

Price:

Sources: https://www.gac-toyota.com.cn/vehicles/newlevin
https://www.gac-toyota.com.cn/minisite/Campaigns/2018/newLevinTable?module=gsjycvt

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Tianjin FAW Toyota Motor Co., Ltd. (TFTM) - Vios, Corolla, Crown, Reiz – **517 thousand units.**

GAC Toyota Motor Co., Ltd. (GTMC) - Camry, Yaris, Highlander, Camry Hybrid, Levin – **439 thousand units.**

Sources:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/asia.html
http://www.gac-toyota.com/
http://www.tjfaw.com/
http://www.tftm.com.cn/english/gsjj/index.htm

Notes: Chinese production of Toyotas is made by two different joint-ventures: Tianjin FAW Toyota Motor (where the discussed model is called “Corolla”) and GAC Toyota Motor (where the discussed model is called “Levin”).

VIETNAM

Type: **Sedan**

Model chosen: **2019 Corolla Altis 1.8 litters, E, CVT (E170)**

Prices:**733,000,000**

Source: http://www.toyota.com.vn/corolla-altis-1-8e-cvt?spy=sec_dt_01

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Toyota Motor Vietnam Co., Ltd. (TMV) - Camry, Corolla, Vios, Innova, Fortuner – **41 thousand units**

Source:

https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/asia.html

Note: Toyota Motor Vietnam Co., Ltd (TMV) is a Joint Venture between Toyota, KUO Singapore, and the Vietnam Engine and Agricultural Machinery Corporation. Source: http://www.toyotavn.com.vn/en/toyota-vietnam/about-us

THAILAND

Type: **Sedan**

Model chosen: **2019 Toyota Corolla Altis, 1.6 litters, G, CVT (E170).**

Prices: **869,000.00**

Source: https://www.toyota.co.th/en/model/altis/specification

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Toyota Motor Thailand Co., Ltd. (TMT) - Corolla, Camry, Camry Hybrid, Vios, Yaris, Hilux, Fortuner **-524 thousand units**

Source:

https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/asia.html

PAKISTAN

Type: **Sedan**

Model chosen: **2018 Corolla Altis 1.6, automatic (E170).**

Price: **2,574,000**

Source: http://www.toyota-indus.com/altis/

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:
Indus Motor Company Ltd. (IMC) - Corolla, Hilux – **61 thousand units**
Source:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/asia.html

Note: Apart from Japan, in all other Asian producers the cheapest automatic model is either 1,6 or 1,8 litres. Therefore, we chose the cheapest model in Pakistan with this engine size (Pakistan is the only Asian producer that still has also a 1,3-cylinder model, costing 2,119,000 – the cheapest Xli automatic)

INDIA
Type: **Sedan**
Model chosen: **2019 Corolla Altis, 1.8, G, CVT (E170).**
Prices:**1,788,000**
Source: https://www.toyotabharat.com/pricelist/

Total production of plants where the model is produced (includes other models as well):
Plant – main models – thousand units produced in 2017:
Toyota Kirloskar Motor Private Ltd. - Corolla, Innova, Fortuner, Etios – **154 thousand units**
Source:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/asia.html

TURKEY
Type: **Sedan (Corolla) and hatchback (Auris)**
Model chosen: **2018 Corolla Sedan Touch Multidrive S 1.6** (E170)
Price: Average of the recommended price (116,850) and the campaign price (102,800) = 110,000
Sources: http://www.toyotatoyan.com.tr/fiyat-listesi
http://turkiye.toyota.com.tr/middle/fiyatl_aksesuar.html#YeniAuris
Total production of plants where the model is produced (includes other models as well):
Plant – main models – thousand units produced in 2017:

Toyota Motor Manufacturing Turkey - Verso, Corolla, C-HR – **280 thousand units**
Source:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/europe.html

Notes: 1) for the European market there are both the Corolla sedan and the Corolla hatchback (in some markets still under the name "Auris"); 2) The hatchback (previously based on the E180 platform), is, from 2019, based on the new E210, as well the new E210 sedan; 3) We chose the sedan version, as comparator, but for illustrative purposes the cheapest automatic hatchback (Auris Active Multidrive S 1.6) costs an average of 122,500 (average of the recommended price (124,750) and the campaign price (120,250)).

SOUTH AFRICA
Type: **Sedan (Corolla) and hatchback (Auris)**
Model chosen: **2019, Toyota Corolla 1.6 Prestige CVT (E170).**
Price: **330,000**
Source: http://www.toyota.co.za/mobi/list-ranges

Total production of plants where the model is produced (includes other models as well):
Plant – main models – thousand units produced in 2017:
Toyota South Africa Motors - Corolla, Hilux, Fortuner, Dyna – **129 thousand units**
Source:
https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/africa.html

Notes: South Africa sells the old generation Corolla as Corolla Quest, for lower prices (1.6 Corolla Quest AT from 235,000), and the hatchback Auris XR CVT from 378,200.

UK
Type: H**atchback**
Model chosen: **Toyota Auris, Icon, 1.2, Petrol Turbo (115 hp) Automatic (E180)**
Prices: **21,520.00**

Source: https://www.toyota.co.uk/new-cars/auris/index/specifications

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Toyota Motor Manufacturing (Burnaston, Derby, UK) - Avensis, Auris, Auris Hybrid – **145 thousand units**

Source:

https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/europe.html

Notes: 1) up to now, the UK produced only the hatchback version, called "Auris" (E180). All production will be replaced by the new E210, from 2019, under the name "Corolla"; 2) The engine options are either 1.2 turbo petrol or 1.8 hybrid. The chosen model was the cheapest automatic 1.2 turbo petrol, before the arrival of the new model, in 2019.

USA

Type: **Sedan and hatchback**

Model chosen: **2019 XLE 1.8L 4-Cylinder, CVT, Sedan (E170)**

Price: **22,135**

Source:

https://www.toyota.com/corolla/2019/features/mileage_estimates/1856/1863/1866

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Toyota Motor Manufacturing, Mississippi - Corolla – **164 thousand units**

Source:

https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/north_america.html

Note: The price includes the charged delivery, processing and handling fee of 920 US dollars.

CANADA

Type: **Sedan and hatchback**

Model chosen: **2019 Toyota COROLLA CE CVT 1.8 Sedan (E170)**

Prices and taxes:

MRSP price: **20,375 Canadian dollars**

Freight, delivery, and other charges: 1,776

Subtotal: 22,151

Sales tax (HST of 13%, based on Ontario province): 2,879

Total retail price including sales taxes, freight and charges: 25,031[159] Canadian dollars.

Invoice price: not available.

Notes on taxes: Some Canadian provinces moved from taxation based on the goods and services tax (GST) and provincial sales tax (PST) to the single harmonized sales tax (HST). In the case of Ontario this is charged at 13% of the retail price, in line with the Canadian average. Federal excise taxes on fuel-inefficient cars, ranging from 1,000 to 4,000 Canadian dollars do not apply to the Corolla. Excise tax of 100 Canadian dollars per air conditioning is included in the calculations.

Sources: https://www.toyota.ca/toyota/en/build-price/corolla
https://www.toyota.ca/toyota/en/build-price-pricing-summary
PWC (2015). 2015 Global Automotive Tax Guide. Available at https://www.pwc.com/gx/en/automotive/pdf/pwc-global-automotive-tax-guide-2015.pdf

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017:

Toyota Motor Manufacturing Canada - Corolla, RX350, RAV4 – **572 thousand units**

[159] Toyota offered a price rebate of 500 Canadian dollars for the 2019 model, but we opted to do not include this in the calculation.

https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/north_america.html

BRAZIL

Type: **Sedan**

Model chosen: **2019 Corolla GLi CVT 1.8, Sedan (E170)**

Price: **90,990**

Source: https://www.toyota.com.br/modelos/corolla/

Total production of plants where the model is produced (includes other models as well):

Plant – main models – thousand units produced in 2017

Toyota do Brasil Ltda - Corolla, Etios – **198 thousand units**

Source:

https://newsroom.toyota.co.jp/en/corporate/companyinformation/worldwide/latin_america.html

APPENDIX III – Regulations consulted for Table 7

Decrees and Resolutions	Date published	Abstract and tariffs							
Portaria MEFP 259/1990	04-May-90	Establishes a tariff of 85% for cars and light commercials							
Portaria MEFP 58/1991	06/feb/1991	Establishes a cronogram for tariffs: from 15/february/1991 to 31/december/1994, and after 1994							
Portaria MEFP 131/1992	19-feb-92	Anticipates the cronogram for the trade liberaliation establieshed in the Portaria 58 (31/jan/91): to: 01/october/1992 what was previously set to 1993; and to 01/july/1993 what was previously set to 1994 and after.							
PORTARIA MF Nº 492/1994	15/09/1994	Modifies the ad valorem tariffs fro cars and light commercials to 20%							
Decreto 1.343/1994	26-dez-94	Establish the Commom External Tariff (TEC) in Mercosur at 20% for vehicles.							
Decreto 1.391/1995	13-fev-95	Establish tariff exceptions for vehicles, for the following timetable:							
		13-fev-95	1-jan-96	1-jan-97	1-jan-98	1/1/9999	1-jan-00	1-jan-01	
		32%	30%	28%	26%	24%	22%	20%	
Decreto 1.427/1995	30-mar-95	Increases the tariffs, as exception, to 70% for up to 1 year.							
Decreto 1.471/1995	28-abr-95	Establishes the following tariff cronogram:							
		1-mai-95	1-jan-96	1-abr-96	1-jan-97	1-jan-98	1-jan-99	1-jan-00	1-jan-01
		70%	62%	30%	28%	26%	24%	22%	20%
Decreto 1.763/1995	27-dez-95	Establishes a 70% tariff for vehicles, after 01/01/1996							
Decreto 1.767/1995	29-dez-95	Reafirms a TEC of 20%, with a renewed cronogram of convergence with tariff exceptions:							
		1-jan-96	1-abr-96	1-jan-97	1-jan-98	1-jan-99			
		70%	70%	63%	49%	35%			
Decreto 1.848/1996	01-abr-96	Renewed cronogram of convergence with tariff exceptions:							
		1-abr-96	1-jan-97	1-jan-98	1-jan-99				
		70%	63%	49%	35%				
Decreto 1.987/1996	21-ago-96	Tariffs reduced to 35% for a quota of 50 thousand vehicles imported by newcomers (from South Corea, Japan, and Europe), up to 1 year							
Decreto 2.307/1997	21-ago-97	Tariffs reduced in 50% (equivalent to 31,5%)for a quota of 50 thousand vehicles imported by newcomers (from South Corea, Japan, and Europe), up to 1 year							
Decreto 2.376/1997	13-nov-97	Add an extra 3% (TEC goes to 23%) and renews the cronogram of convergence with tariff exceptions:							
		1-jan-97	1-jan-98	1-jan-99					
		63%	49%	35%					
Decreto 2.624/1998	15-jun-98	Renews the cronogram of convergence with tariff exceptions:							
		1-jan-98	1-jan-99						
		49%	35%						
Decreto 2.770/1998	04-set-98	Tariffs reduced in 50% (equivalent to 24,5%)for a quota of 50 thousand vehicles imported by newcomers (from South Corea, Japan, and Europe), up to 1 year							
Decreto 3.317/1999	31-dez-99	Establishes 35% as the exception tariff for vehicles during the year 2000							
Decreto 3.704/2000	28-dez-00	Establishes 35% as the exception tariff for vehicles							
Resolução CAMEX 07/2001	26-mar-01	Establishes 35% as the exception tariff for vehicles							
Resolução CAMEX 42/2001	29-dez-01	Establishes 35% as the TEC tariff for vehicles							

Sources: Legislation database at the Brazilian Revenue Scretariat (http://normas.receita.fazenda.gov.br/sijut2consulta/consulta.action)
Legislation database at the Brazilian Presidency (http://www4.planalto.gov.br/legislacao/)

APPENDIX IV – COST STRUCTURE IN THE BRAZILIAN MARKET

	TOTAL MANUFACTURING	TRACTORS FOR AGRICULTURE	VEHICLES, CHASSIS AND TRAILLERS	CARS, SUVs AND LIGHT COMMERCIALS	TRUCKS AND BUSES	CABINS AND CHASSIS	AUTOPARTS
REVENUE							
GROSS REVENUE							
SALES AND SERVICES	3,119,834,233.00	4,748,545.00	280,077,161.00	149,928,958.00	27,677,115.00	10,158,886.00	92,114,219.00
DEDUCTIONS							
TAXES ON REVENUE AND RETURNED ITEMS (1) (E)	587,293,171.00	636,921.00	60,868,834.00	35,062,040.00	3,792,954.00	1,820,776.00	20,172,149.00
OTHER REVENUES							
FINANCIAL, OTHER OPERATIONAL AND NON-OPERATIONAL INCOMES	376,096,551.00	454,229.00	28,249,457.00	16,578,858.00	2,334,406.00	1,818,916.00	7,514,483.00
TOTAL NET REVENUE	2,908,637,610.00	4,565,853.00	247,457,779.00	131,445,776.00	26,218,566.00	10,157,026.00	79,456,549.00
COSTS							
TOTAL LABOUR EXPENSES	380,058,056.00	591,851.00	37,088,675.00	13,846,522.00	3,711,215.00	2,436,958.00	17,007,848.00
WAGES	244,330,588.00	393,211.00	24,313,417.00	8,957,701.00	2,267,931.00	1,711,652.00	11,309,888.00
TAXES ON WAGES, PENSION CONTRIBUTIONS, BENEFITS...							
INPUTS							
PURCHASES OF RAW MATERIALS AND INPUTS (N)	1,135,273,711.00	2,760,158.00	122,892,072.00	68,845,458.00	12,656,774.00	4,616,902.00	36,738,668.00
PURCHASES OF GOODS FOR RESELLING (O)	197,555,257.00	356,460.00	17,560,132.00	14,125,524.00	1,573,317.00	87,606.00	1,756,483.00
DIRECT PRODUCTION COSTS							
FUEL FOR MACHINES (I)	24,699,327.00	7,444.00	618,216.00	168,158.00	88,308.00	42,886.00	317,876.00
ELETRICITY (J)	41,400,612.00	19,029.00	2,233,254.00	497,057.00	107,704.00	94,611.00	1,531,775.00
PARTS, ACESSORIES AND SMALL TOOLS (K)	25,464,579.00	14,496.00	2,301,887.00	137,093.00	917,007.00	134,112.00	1,110,297.00
INDUSTRIAL SERVICES (L)	59,897,679.00	32,251.00	1,904,898.00	543,585.00	308,391.00	58,875.00	991,356.00
MAINTENANCE AND REPAIR OF MACHINES (M)	22,862,807.00	14,222.00	1,561,933.00	362,188.00	204,581.00	62,723.00	931,443.00
OTHER COSTS AND EXPENSES							
RENTS	74,067,929.00	19,353.00	1,168,688.00	251,573.00	110,916.00	105,054.00	698,909.00
LEASING	2,013,566.00	8,273.00	75,775.00	20,106.00	12,391.00	3,600.00	38,969.00
DEPRECIATION AND AMORTIZATION	122,167,803.00	79,072.00	9,761,276.00	5,929,779.00	589,932.00	268,057.00	2,970,177.00
ADVSERTISING	27,261,921.00	9,990.00	4,787,782.00	4,608,332.00	74,904.00	9,344.00	95,050.00
FREIGHT	75,232,746.00	150,733.00	5,021,562.00	3,340,817.00	505,531.00	106,676.00	1,068,195.00
TAXES	16,760,684.00	9,788.00	1,635,501.00	769,676.00	277,873.00	51,302.00	532,212.00
INSURANCE	4,045,710.00	5,125.00	253,089.00	93,027.00	44,710.00	10,795.00	104,027.00
PASSIVE MONETARY VARIATIONS	112,305,278.00	107,854.00	10,842,258.00	6,110,526.00	1,201,345.00	516,176.00	3,014,181.00
FINANCIAL EXPENSES	180,675,603.00	195,976.00	13,142,766.00	7,966,234.00	716,183.00	784,035.00	3,669,349.00
NEGATIVE RESULTS FROM PARTICIPATION IN OTHER FIRMS	34,111,876.00	99,096.00	1,068,165.00	1,570.00	230,936.00	174,284.00	661,374.00
SERVICES FROM THIRD PARTIES	62,403,479.00	82,261.00	4,724,993.00	2,038,847.00	490,464.00	169,724.00	2,022,085.00
SALES EXPENSES	61,556,363.00	130,616.00	8,054,681.00	5,345,023.00	1,479,583.00	220,484.00	1,003,623.00
WATER AND SEWAGE	2,048,221.00	2,707.00	162,066.00	67,348.00	12,386.00	9,485.00	72,313.00
TRAVEL	9,174,524.00	21,099.00	765,361.00	249,148.00	98,267.00	33,718.00	383,628.00
OTHER OPERATIONAL COSTS AND EXPENSES	101,768,830.00	68,959.00	10,003,866.00	4,076,517.00	1,752,731.00	383,050.00	3,779,432.00
NON-OPERATIONAL COSTS AND EXPENSES	75,246,703.00	4,358.00	3,517,399.00	989,851.00	579,708.00	261,599.00	1,686,169.00
ROYALTIES AND TECHNICAL ASSISTANCE	7,021,860.00	898.00	1,787,035.00	1,143,314.00	252,700.00	66,175.00	324,800.00
TOTAL COSTS AND EXPENSES	2,855,075,124.00	4,792,069.00	262,933,330.00	141,527,273.00	27,997,857.00	10,708,231.00	82,510,239.00
PROFIT BEFORE TAXES							
PROFIT BEFORE TAXES	53,562,486.00	-226,216.00	-15,475,551.00	-10,081,497.00	-1,779,291.00	-551,205.00	-3,053,690.00
VALUE ADDED							
VALUE ADDED							

	ENGINE PARTS	TRANSMISSIONS AND GEARBOX PARTS	BRAK SYSTEM PARTS	DRIVING WHEEL AND BUMPER SYSTEMS PARTS	ELECTRIC AND ELCTRONIC MATERIAL PARTS, EXCEPT BATTERIES	OTHER AUTOPARTS	AIRCRAFTS	AIRCRAFTS TURBINES AND PARTS	MOTORCYCLES
REVENUE									
GROSS REVENUE									
SALES AND SERVICES	15,029,780.00	8,618,458.00	5,759,935.00	9,533,134.00	17,246,348.00	35,926,564.00	(x)	1,181,424.00	11,586,554.00
DEDUCTIONS									
TAXES ON REVENUE AND RETURNED ITEMS (1) (E)	3,005,366.00	1,919,899.00	1,347,894.00	2,238,144.00	3,750,544.00	7,910,302.00	(x)	75,081.00	1,521,373.00
OTHER REVENUES									
FINANCIAL, OTHER OPERATIONAL AND NON-OPERATIONAL INCOMES	1,579,417.00	649,273.00	416,265.00	453,901.00	1,807,076.00	2,608,551.00		157,582.00	1,165,509.00
TOTAL NET REVENUE	13,603,830.00	7,347,831.00	4,828,306.00	7,748,889.00	15,302,880.00	30,624,813.00	(x)	1,263,925.00	11,230,690.00
COSTS									
TOTAL LABOUR EXPENSES	3,280,749.00	1,702,243.00	939,371.00	1,441,304.00	3,274,717.00	6,369,464.00	(x)	321,198.00	1,754,133.00
WAGES	2,215,886.00	1,188,114.00	588,933.00	926,465.00	2,198,640.00	4,191,850.00	(x)	237,773.00	1,001,967.00
TAXES ON WAGES, PENSION CONTRIBUTIONS, BENEFITS...									
INPUTS									
PURCHASES OF RAW MATERIALS AND INPUTS (N)	5,157,501.00	3,255,510.00	2,813,194.00	4,034,847.00	6,215,168.00	15,262,448.00	(x)	412,536.00	5,484,569.00
PURCHASES OF GOODS FOR RESELLING (O)	223,313.00	59,872.00	25,582.00	331,881.00	484,431.00	631,404.00	(x)	401.00	353,640.00
DIRECT PRODUCTION COSTS									
FUEL FOR MACHINES (I)	102,796.00	38,970.00	19,705.00	47,008.00	14,927.00	94,470.00	(x)	1,027.00	17,546.00
ELETRICITY (J)	476,771.00	203,081.00	117,814.00	100,956.00	152,730.00	480,423.00	(x)	14,323.00	85,747.00
PARTS, ACESSORIES AND SMALL TOOLS (K)	344,863.00	160,685.00	49,823.00	66,985.00	125,356.00	362,585.00	(x)	32,459.00	28,235.00
INDUSTRIAL SERVICES (L)	155,914.00	144,357.00	37,885.00	95,194.00	163,684.00	394,322.00	(x)	56,174.00	57,908.00
MAINTENANCE AND REPAIR OF MACHINES (M)	171,239.00	123,122.00	35,299.00	69,741.00	146,718.00	385,324.00	(x)	44,623.00	98,526.00
OTHER COSTS AND EXPENSES									
RENTS	92,591.00	62,764.00	23,455.00	62,492.00	102,983.00	354,624.00	(x)	13,829.00	54,640.00
LEASING	3,166.00	3,792.00	8,382.00	3,178.00	9,380.00	11,071.00	(x)	1.00	1,463.00
DEPRECIATION AND AMORTIZATION	642,656.00	265,140.00	152,537.00	217,362.00	481,604.00	1,210,878.00	(x)	49,002.00	468,476.00
ADVSERTISING	24,259.00	8,552.00	6,466.00	13,042.00	26,144.00	16,587.00	(x)	469.00	93,175.00
FREIGHT	225,651.00	71,849.00	99,106.00	130,734.00	175,764.00	365,091.00	(x)	11,956.00	298,217.00
TAXES	58,239.00	40,144.00	38,510.00	23,426.00	245,386.00	126,507.00	(x)	8,551.00	80,841.00
INSURANCE	21,969.00	12,092.00	6,480.00	13,421.00	16,160.00	33,905.00	(x)	1,409.00	24,489.00
PASSIVE MONETARY VARIATIONS	562,962.00	300,389.00	192,154.00	112,726.00	1,108,199.00	737,751.00	(x)	77,923.00	315,131.00
FINANCIAL EXPENSES	822,894.00	226,122.00	154,640.00	395,937.00	518,384.00	1,551,372.00	(x)	59,982.00	158,785.00
NEGATIVE RESULTS FROM PARTICIPATION IN OTHER FIRMS	228,223.00	229,901.00	1,376.00	15,888.00	93,395.00	92,591.00	(x)	37.00	30,246.00
SERVICES FROM THIRD PARTIES	296,946.00	265,179.00	101,302.00	238,402.00	344,340.00	775,916.00	(x)	109,845.00	176,058.00
SALES EXPENSES	154,500.00	43,564.00	46,265.00	41,033.00	558,515.00	159,746.00	(x)	157.00	322,324.00
WATER AND SEWAGE	16,024.00	7,059.00	4,860.00	8,064.00	9,555.00	26,751.00	(x)	1,544.00	1,961.00
TRAVEL	49,356.00	30,987.00	17,049.00	28,071.00	77,560.00	180,605.00	(x)	5,146.00	28,422.00
OTHER OPERATIONAL COSTS AND EXPENSES	546,362.00	249,309.00	169,026.00	422,789.00	1,061,515.00	1,330,431.00	(x)	37,262.00	254,239.00
NON-OPERATIONAL COSTS AND EXPENSES	546,993.00	101,837.00	29,635.00	11,964.00	534,321.00	461,419.00	(x)	11,700.00	371,833.00
ROYALTIES AND TECHNICAL ASSISTANCE	42,614.00	19,673.00	46,479.00	11,525.00	59,487.00	145,022.00	(x)	0.00	79,749.00
TOTAL COSTS AND EXPENSES	14,248,551.00	7,626,193.00	5,136,395.00	7,937,970.00	16,000,423.00	31,560,707.00		1,271,554.00	10,640,353.00
PROFIT BEFORE TAXES									
PROFIT BEFORE TAXES	-644,721.00	-278,362.00	-308,089.00	-189,081.00	-697,543.00	-935,894.00	(X)	-7,629.00	590,337.00
VALUE ADDED									
VALUE ADDED									

APPENDIX V – TOTAL FACTOR PRODUCTIVITY

Data for the Brazilian automotive sector						
Year	Y	K	L	IPCA Index 01/01/1996 =100	Y at constant prices	K at constant prices
1996	6.682.387	115.950	72.910	109,56	23.405.297,28	406.118,98
1997	7.436.077	118.704	77.070	115,28	24.753.015,79	395.138,73
1998	6.895.016	98.411	55.257	117,18	22.579.386,41	322.270,46
1999	5.160.424	115.231	56.706	127,66	15.512.252,78	346.384,79
2000	7.873.988	127.036	53.982	135,28	22.335.789,14	360.357,33
2001	7.840.034	143.954	51.721	145,65	20.655.218,12	379.258,72
2002	10.061.752	207.112	51.242	163,90	23.556.845,26	484.896,20
2003	11.804.667	268.934	50.724	179,15	25.285.823,32	576.061,79
2004	15.183.695	281.836	55.135	192,76	30.226.548,47	561.057,73
2005	16.386.651	299.998	57.617	203,73	30.865.079,05	565.061,28
2006	19.062.236	316.820	57.099	210,13	34.811.593,56	578.578,98
2007	23.334.130	365.787	65.054	219,50	40.793.564,37	639.481,97
2008	30.428.750	451.189	73.118	232,45	50.233.000,87	744.840,90
2009	30.500.956	471.292	71.321	242,47	48.271.588,10	745.878,70
2010	34.447.856	514.647	78.328	256,80	51.475.830,74	769.042,98
2011	35.589.195	593.117	79.603	273,49	49.935.536,95	832.208,09
2012	36.743.163	556.398	83.144	289,46	48.710.015,48	737.610,84
2013	38.251.858	546.989	83.023	306,57	47.880.347,65	684.673,24
2014	35.407.632	501.675	84.944	326,22	41.650.402,23	590.126,04
2015	27.558.204	609.507	77.530	361,03	29.291.615,03	647.844,99
2016	25.074.617	664.133	71.509	383,74	25.074.617,00	664.133,00
2017	28.988.500	585.205	72.094	383,74	28.988.500,00	585.205,00
Source: PIA/IBGE and author`s calculations						

Results for the Brazilian automotive sector											
ΔY	ΔK	ΔL	αΔK	(1-α)ΔL	ΔA	ΔA moving average	ΔA index for the automotive sector	Labour Productivity	Capital Intensity	Change in units produced (% from previous year)	Total scale (production, in units)
							100	321,02	5,57		1.738.273
5,76%	-2,70%	5,71%	-1,62%	2,28%	5,10%		105,10	321,18	5,13	14,16%	1.984.403
-8,78%	-18,44%	-28,30%	-11,06%	-11,32%	13,60%	9,35%	119,40	408,62	5,83	-24,54%	1.497.409
-31,30%	7,48%	2,62%	4,49%	1,05%	-36,84%	-11,62%	75,41	273,56	6,11	-14,42%	1.281.463
43,99%	4,03%	-4,80%	2,42%	-1,92%	43,49%	3,33%	108,21	413,76	6,68	24,13%	1.590.716
-7,52%	5,25%	-4,19%	3,15%	-1,68%	-9,00%	17,25%	98,48	399,36	7,33	7,81%	1.714.893
14,05%	27,85%	-0,93%	16,71%	-0,37%	-2,29%	-5,64%	96,22	459,72	9,46	-0,94%	1.698.848
7,34%	18,80%	-1,01%	11,28%	-0,40%	-3,54%	-2,92%	92,81	498,50	11,36	1,29%	1.720.800
19,54%	-2,60%	8,70%	-1,56%	3,48%	17,62%	7,04%	109,17	548,23	10,18	26,70%	2.180.206
2,11%	0,71%	4,50%	0,43%	1,80%	-0,12%	8,75%	109,04	535,69	9,81	8,99%	2.376.296
12,79%	2,39%	-0,90%	1,44%	-0,36%	11,71%	5,80%	121,81	609,67	10,13	3,97%	2.470.613
17,18%	10,53%	13,93%	6,32%	5,57%	5,30%	8,50%	128,26	627,07	9,83	13,46%	2.803.051
23,14%	16,48%	12,40%	9,89%	4,96%	8,30%	6,80%	138,91	687,01	10,19	7,10%	3.002.091
-3,90%	0,14%	-2,46%	0,08%	-0,98%	-3,01%	2,65%	134,73	676,82	10,46	0,67%	3.022.183
6,64%	3,11%	9,82%	1,86%	3,93%	0,84%	-1,08%	135,87	657,18	9,82	12,66%	3.404.663
-2,99%	8,21%	1,63%	4,93%	0,65%	-8,57%	-3,86%	124,22	627,31	10,45	-7,41%	3.152.355
-2,45%	-11,37%	4,45%	-6,82%	1,78%	2,59%	-2,99%	127,44	585,85	8,87	3,05%	3.248.601
-1,70%	-7,18%	-0,15%	-4,31%	-0,06%	2,66%	2,62%	130,83	576,71	8,25	7,55%	3.494.014
-13,01%	-13,81%	2,31%	-8,29%	0,93%	-5,65%	-1,50%	123,43	490,33	6,95	-14,49%	2.987.817
-29,67%	9,78%	-8,73%	5,87%	-3,49%	-32,05%	-18,85%	83,87	377,81	8,36	-21,37%	2.349.390
-14,40%	2,51%	-7,77%	1,51%	-3,11%	-12,80%	-22,42%	73,14	350,65	9,29	-10,76%	2.096.528
15,61%	-11,88%	0,82%	-7,13%	0,33%	22,41%	4,81%	89,53	402,09	8,12	25,62%	2.633.699

Data for the Brazilian manufacturing sector						
Year	Y	K	L	IPCA Index 01/01/1996 =100	Y at constant prices	K at constant prices
1996	156.966.503	7691958	3717583	109,56	549.780.739,37	26.941.355,48
1997	169.148.743	8308333	3659383	115,28	563.057.847,07	27.656.558,42
1998	169.384.564	8644425	3573259	117,18	554.690.449,34	28.308.246,48
1999	203.905.908	10009779	3680099	127,66	612.941.879,93	30.089.431,04
2000	247.457.251	12656572	4004852	135,28	701.950.902,02	35.902.330,99
2001	282.129.928	14777811	4102382	145,65	743.294.633,71	38.933.365,53
2002	324.556.941	18188147	4189517	163,90	759.861.467,27	42.582.580,50
2003	395.291.392	24287372	4507264	179,15	846.721.749,74	52.024.017,05
2004	463.813.873	27516414	4886680	192,76	923.325.482,72	54.777.590,15
2005	486.396.854	30252139	4861375	203,73	916.152.870,28	56.981.421,14
2006	529.683.718	35452012	5141027	210,13	967.312.245,23	64.742.721,29
2007	570.330.904	36456542	5427973	219,50	997.072.976,19	63.734.636,47
2008	679.707.725	45360149	5666912	232,45	1.122.088.772,70	74.882.353,18
2009	635.745.620	40446507	5715537	242,47	1.006.147.174,63	64.011.669,86
2010	758.504.962	48934229	6110687	256,80	1.133.442.761,78	73.122.985,93
2011	834.699.115	53762567	6259891	273,49	1.171.174.242,53	75.434.767,51
2012	883.816.649	58119277	6261996	289,46	1.171.666.213,34	77.048.099,61
2013	969.660.368	59579670	6406944	306,57	1.213.736.481,10	74.576.647,04
2014	1.000.085.015	63638601	6268879	326,22	1.176.411.434,12	74.858.813,75
2015	1.008.862.833	77909550	5681774	361,03	1.072.320.305,20	82.810.060,70
2016	1.019.713.934	69936533	5356413	383,74	1.019.713.934,00	69.936.533,00
2017	1.073.515.793	69262095	5359281	383,74	1.073.515.793,00	69.262.095,00
Source: PIA/IBGE and author`s calculations						

Results for the Brazilian manufacturing sector									
ΔY	ΔK	ΔL	αΔK	(1-α)ΔL	ΔA	ΔA moving average	ΔA index for the overall manufacturing	Labour Productivity	Capital Intensity
							100	147,89	7,25
2,41%	2,65%	-1,57%	1,59%	-0,63%	1,45%		101,45	153,87	7,56
-1,49%	2,36%	-2,35%	1,41%	-0,94%	-1,96%	-0,26%	99,46	155,23	7,92
10,50%	6,29%	2,99%	3,78%	1,20%	5,53%	1,79%	104,96	166,56	8,18
14,52%	19,32%	8,82%	11,59%	3,53%	-0,60%	2,47%	104,33	175,28	8,96
5,89%	8,44%	2,44%	5,07%	0,97%	-0,15%	-0,37%	104,18	181,19	9,49
2,23%	9,37%	2,12%	5,62%	0,85%	-4,24%	-2,20%	99,75	181,37	10,16
11,43%	22,17%	7,58%	13,30%	3,03%	-4,91%	-4,58%	94,86	187,86	11,54
9,05%	5,29%	8,42%	3,18%	3,37%	2,50%	-1,20%	97,24	188,95	11,21
-0,78%	4,02%	-0,52%	2,41%	-0,21%	-2,98%	-0,24%	94,34	188,46	11,72
5,58%	13,62%	5,75%	8,17%	2,30%	-4,89%	-3,94%	89,72	188,16	12,59
3,08%	-1,56%	5,58%	-0,93%	2,23%	1,78%	-1,56%	91,32	183,69	11,74
12,54%	17,49%	4,40%	10,49%	1,76%	0,28%	1,03%	91,58	198,01	13,21
-10,33%	-14,52%	0,86%	-8,71%	0,34%	-1,97%	-0,84%	89,78	176,04	11,20
12,65%	14,23%	6,91%	8,54%	2,77%	1,35%	-0,31%	90,99	185,49	11,97
3,33%	3,16%	2,44%	1,90%	0,98%	0,46%	0,90%	91,40	187,09	12,05
0,04%	2,14%	0,03%	1,28%	0,01%	-1,25%	-0,40%	90,25	187,11	12,30
3,59%	-3,21%	2,31%	-1,92%	0,93%	4,59%	1,67%	94,39	189,44	11,64
-3,08%	0,38%	-2,15%	0,23%	-0,86%	-2,44%	1,07%	92,09	187,66	11,94
-8,85%	10,62%	-9,37%	6,37%	-3,75%	-11,48%	-6,96%	81,52	188,73	14,57
-4,91%	-15,55%	-5,73%	-9,33%	-2,29%	6,71%	-2,38%	87,00	190,37	13,06
5,28%	-0,96%	0,05%	-0,58%	0,02%	5,83%	6,27%	92,07	200,31	12,92

APPENDIX VI – DATA FOR MULTIVARIATE REGRESSION

Dependent variable: markups for automakers

Time	CARMARKUP	DUMMYINOVAR	REERTARIFFS	HHI	YTOTAL
1996	0,075839724	0	1,643623957	2928,084	1738273
1997	0,157104635	0	1,53583379	2784,403	1984403
1998	-0,033085194	0	1,443307263	2675,312	1497409
1999	-0,131573577	0	1,965271511	2587,562	1281463
2000	-0,001747111	0	1,822242481	2520,338	1590716
2001	-0,055952672	0	2,182079605	2501,432	1714893
2002	-0,158933647	0	2,289051089	2380,947	1698848
2003	-0,087463372	0	2,422166539	2143,072	1720800
2004	0,076420954	0	2,306739666	2115,781	2180206
2005	0,006392612	0	1,888969403	2057,456	2376296
2006	0,08104643	0	1,692844022	2076,981	2470613
2007	0,117408286	0	1,57498254	2041,645	2803051
2008	0,204969625	0	1,507559425	1941,828	3002091
2009	0,091557043	0	1,520823398	1961,945	3022183
2010	0,084919033	0	1,34	1995,958	3404663
2011	0,006834627	0	1,294703757	1869,982	3152355
2012	0,054219065	1	1,760453396	1857,104	3248601
2013	-0,066973054	1	1,865629521	1550,94	3494014
2014	-0,004333079	1	1,883270373	1506,906	2987817
2015	-0,175966256	1	2,234182705	1295,943	2349390
2016	-0,119644228	1	2,094748837	1198,653	2096528
2017	-0,066757375	1	1,910503679	1247,143	2633699
2018		0	1,695143531	1226,857	2748358

Dependent variable: markups for autopart producers

Time	AUTIOARTMARKUP	DUMMYINOVAR	REERTARIFFS	HHI	YTOTAL
1996	0,124416022	0	1,643623957	2928,084	1738273
1997	0,143536602	0	1,53583379	2784,403	1984403
1998	0,124005483	0	1,443307263	2675,312	1497409
1999	0,073631547	0	1,965271511	2587,562	1281463
2000	0,110043911	0	1,822242481	2520,338	1590716
2001	0,112999675	0	2,182079605	2501,432	1714893
2002	0,029539808	0	2,289051089	2380,947	1698848
2003	0,107328942	0	2,422166539	2143,072	1720800
2004	0,205697652	0	2,306739666	2115,781	2180206
2005	0,181370248	0	1,888969403	2057,456	2376296
2006	0,188731614	0	1,692844022	2076,981	2470613
2007	0,222066049	0	1,57498254	2041,645	2803051
2008	0,229550696	0	1,507559425	1941,828	3002091
2009	0,294384306	0	1,520823398	1961,945	3022183
2010	0,28492701	0	1,34	1995,958	3404663
2011	0,267543349	0	1,294703757	1869,982	3152355
2012	0,224706483	1	1,760453396	1857,104	3248601
2013	0,228150238	1	1,865629521	1550,94	3494014
2014	0,167193459	1	1,883270373	1506,906	2987817
2015	0,026448334	1	2,234182705	1295,943	2349390
2016	0,064699607	1	2,094748837	1198,653	2096528
2017	0,153785856	1	1,910503679	1247,143	2633699
2018		0	1,695143531	1226,857	2748358