Impact of supply chain on the competitiveness of the automotive industry

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Abstract

Purpose – There is a great reliance on fiscal incentives to sustain the automotive industry competitiveness due to several structural problems, among them the inefficiency of the supply chain. This paper aims to compare the supply chain structure of traditional automotive industry with the supply chains from South Korea and China. Based on strategic decision and transaction cost theory, this comparison seeks to exploit the factors that led to the inefficiency of automotive supply chains.

Design/methodology/approach – The authors used a qualitative approach and applied a multi-method research. They conducted semi-structured interviews with six executives from automakers representing the selected countries, carried individual meetings during one workshop and used secondary data from several sources.

Findings – Concepts identified in the research such as reliability, supply chain governance and automaker competencies led the authors to propose that the traditional automakers have higher transaction costs when compared to the new automakers due to the horizontal structure of their supply chain. While new competitors have vertical upstream supply chains, which indicates better profitability, traditional automotive industry is horizontal, depends on fewer Tier 1 suppliers and is disconnected from Tier 2, impacting negatively in the transaction costs and supply chain management.

Practical implications – This study suggests that automotive executives rethink the current upstream supply chain model by identifying the competencies required for their current and future competitiveness and implementing a vertical integration of these competencies.

Originality/value – This research exploited the inefficiency of supply chain as one of the explanations for the low competitiveness of the national automotive industry.

Keyword Automotive industry

Paper type Research paper

1. Introduction

The automotive industry is very strong in the Brazilian economy: it represents 23 per cent of industrial GDP and 5 per cent of total GDP (Anfavea, 2015). Brazil is the fourth largest

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market and the seventh largest manufacturer in the world, with 31 automakers installed, 64 industrial plants, more than 500 direct automotive parts (first tier of the supply chain), 5,533 resellers spread throughout Brazil, involving almost 200 thousand companies directly or indirectly linked with the automotive supply chain. This industry contributes to the national economy by generating around 1.5 million direct and indirect jobs; tax collection of approximately US$58bn; and annual revenues of roughly US$110.9bn (Anfavea, 2015).

The Brazilian automotive market grew 137 per cent from 2002 to 2014, with an annual average rate of over 10 per cent per year (Anfavea, 2015), well above the growth of the national economy, which in the same period was 3.46 per cent per year (IBGE, 2015). Such accelerated growth is the result of a macroeconomic policy based on consumption, which showed a slowdown from 2015 onwards, evidenced by a significant decline in sales volumes of the automotive industry. The sales peak reached in 2013 (3.71 million units) rapidly declined, reaching in 2016 an equivalent result of ten years ago (2.16 million units) (Anfavea, 2017).

There was a remarkable expansion of vehicle imports in the 2002-2014 period: 475 per cent, which is significantly higher than the market growth in this period (137 per cent) and the exports growth (138 per cent) (Anfavea, 2015).

This imbalance clearly shows the inability of the domestic industry to meet the growing demand with appropriate products (idealised, designed and manufactured locally with a high percentage of domestic components) that meet the requirements and expectations of increasingly sophisticated customers. Imported vehicles technologically updated, with higher value added and lower prices, gained market share despite import taxes and the unfavorable exchange rate in Brazil (Sakuramoto, Laigner, & Garcia, 2014).

Several hypotheses are identified as causes for the Brazilian automotive sector to become unable to compete with imported vehicles, especially: products and accessories with outdated technology; lagged manufacturing technology; inefficient supply chain; low skilled workforce in high technology product and process development (Agénor, Canuto, & Jelenic, 2012; Eichengreen, Park, & Shin, 2011, 2013; Felipe, Arnelyn, & Utsav, 2012). Macroeconomic policies with a high degree of interventionism may have induced the entire industry to accommodate and enable the supply chain, supporting institutions, demand and competition to be shaped by these policies.

This research aims to explore one of the hypotheses listed above: supply chain inefficiency is a cause for the low competitiveness of the domestic automotive industry. Supply chain can be defined as a set of companies aligned with the objective of delivering products or services to the consumer market (Lambert, Stock, & Ellram, 1998). In the present research, the focus is on the automaker and the different levels of supplier companies: Tier 1, encompassing the direct suppliers of an automaker, and Tier 2, formed by companies that supply materials and byproducts for Tier 1.

The automakers installed in Brazil underwent a vertical disintegration movement, which began in the late 1970s driven by the increasing demand for product quality and the alignment with the headquarters, which sought to follow the Japanese model by reducing production costs and accelerating product development (Vanalle & Salles, 2011). Automakers have structured their supply chains prioritizing the use of suppliers to provide most of the parts, subsystems, systems and modules for use in the vehicles, rather than producing them internally. There was a transition from a vertical integration model to a horizontal model which, on the one hand, enabled the reduction of production costs but, on the other hand, increased the incidence of transaction costs.

Recently, with the implementation in Brazil of South Korean and Chinese automaker plants, a distinct supply chain arrangement is observed: there is a strong verticalization.

These automakers internalized the development and production of several parts and outsourced others to suppliers with which they have shareholder participation. In addition, these countries have used macroeconomic policies to foster their automotive industries, promoting global market share growth and internationalization. These countries occupy respectively the fifth and first place in the production of vehicles worldwide (OICA, 2016).

Given this context, in which there are different supply chain arrangements with different results, the question that we intend to answer herein is: What are the factors that differentiate the structure and management of the supply chain of the national automotive industry from countries such as South Korea and China?

The objective is to evaluate the impact of the supply chain structure of the national automotive industry on its competitiveness, crosschecking it with supply chains of other two countries that have stood out in the automotive industry over the past decade, South Korea and China. Through this comparison, we seek to understand the similarities and differences that may contribute to the understanding of the problem and the long-term competitiveness of the national industry. Supply chain, strategic decision-making and transaction cost theory are the theoretical lenses used in this research, which is based on a qualitative approach.

The following sections will detail the theoretical basis necessary to analyze the problem (Section 2) and the methodology used in the research (Section 3). A discussion of the results based on the theory will be further developed (Section 4), concluding the paper with aspects that must be considered for the re-adaptation of the supply chain of the national automotive industry, as well as contributions and limitations of this study (Section 5).

2. Literature review

Initially, we will bring up aspects related to the macroeconomic factors that influence the automotive chain in the three countries, deepening later the literature on supply chain and make-or-buy decision.

2.1 Macroeconomic factors that influence the automotive market

The level of competitiveness achieved by a nation and by companies installed in it depends on the quality and synergy of a set of factors related to macroeconomics and microeconomics. The Global Competitive Index (GCI) groups the factors into 12 pillars, classifying them into three distinct groups: economies based on basic factors, on efficiency and on innovation and sophistication, clustered, respectively, in low-income, middle-income and high-income countries (Global Competitiveness Report 2016-2017, 2016). As countries manage to increase their population's income, the macroeconomic impacts on business competitiveness are reduced. The higher the income of the country, the lower the impact of macroeconomic changes; in contrast, the impact generated by microeconomics increases (Porter & Schwab, 2014; Table I). According to the GCI, Brazil is positioned among the intermediate developing countries (based on efficiency), with a medium income profile, characterized by a relevant impact of macroeconomic policies on corporate actions (microeconomic policies).

	Low income (%)	Middle income (%)	High income (%)
Microeconomics	21	35	48
Macroeconomics	79	65	52

Source: Porter & Schwab (2014) – GCR 2014-2015 (Global Competitiveness Report)

Table I. Impacts on competitiveness

In this condition, Brazil has been losing competitiveness to the countries in the first group (basic factors), where resources are abundant, and labor costs are low. On the other hand, Brazil is unable to compete with the countries classified in the third group (based on innovation and sophistication), where the products are technologically unique and differentiated, conceived and produced by highly qualified and trained labor (Agénor et al., 2012; Eichengreen et al., 2011, 2013; Global Competitiveness Report 2016-2017, 2016; Porter et al., 2008; Porter & Schwab, 2008, 2014; Wu, 2013).

Compared to China and South Korea (Table II), it is noteworthy that Brazil is weak in the main requirements that can leverage business performance in a country: infrastructure, education, product and labor market efficiency.

2.2 Organizational boundaries and supply chain structure

Supply chains are complex systems where the risks and costs associated with mismanagement and communication failures in globally connected organizational networks are relatively high (Marsillac & Roh, 2013). The study of supply chain management as an integrated discipline gained momentum in the 1980s, mainly because of the successful application of the lean program developed by Toyota (Holweg, 2007). At that time, Toyota and Honda outsourced about 80 per cent of the value of the cars they produced, using collaborative relationships with few suppliers for each automotive part (typically two suppliers for each item), while US automakers outsourced only about 30 per cent, denoting a high vertical integration, and at the same time using several suppliers for each purchased item (Corrêa, 2010). US automakers were still under the influence of an intense verticalization of the production originated in the birth of the automotive industry.

This example shows how supply chain arrangements can be different within a single industry. In this research, we will emphasize the strategic decision-making and the decision through transaction cost analysis.

2.2.1 Strategic decision-making. The boundaries of a company are a long-term strategic commitment, which has consequences in its performance (Novak & Stern, 2008). The decision about the organizational boundaries can be divided into making internally (vertical integration) or buying in the market (outsourcing or horizontal integration). To make or to

Table II. Comparison between Brazil, China and South Korea based on the global competitiveness index

Global competitiveness index	Brazil	China	South Korea
# Ranking 2016	81	28	26
# Ranking 2012	48	29	19
Comparative position (in relation to 138 countries)			
Infrastructure	72	42	10
Goods market efficiency	128	56	24
Labor market efficiency	117	39	77
Higher education and training	84	54	25
Technological readiness	59	74	28
Innovation	100	30	20
Stage	Based on efficiency	Based on efficiency	Based on innovation
GDP (U$bn)	1,772.60	10,982.80	1,376.90
GDP per capita (US$)	8,670.00	7,989.70	27,195.20
Population (million)	204.50	1,374.60	50.60

Source: GCR 2016-2017 (Global Competitiveness Report); prepared by the authors

buy a determined product or service is not only an economic decision based on the best cost; it is a strategic decision for the company (Prahalad & Hamel, 1990; Quinn & Hilmer, 1994). There is a large number of research related to this area, whose outcomes seek to understand the conundrum between vertically integrating and outsourcing (Baker & Hubbard, 2004; David & Han, 2004; Nickerson & Silverman, 2003).

Some companies consider outsourcing a critical element of their strategy (Holcomb & Hitt, 2007) as outsourcing can be a way to reduce costs and improve performance by leaving the activity in the hands of experts. Gilbert, Xia and Yu (2006) show that competing companies can benefit from lower costs when outsourcing their production to a common supplier. However, outsourcing should always be seen from a strategic perspective, not only to reduce costs but mainly to avoid losing the competencies of the company and to use the capabilities of specialized suppliers, more developed than the company and capable of improving performance (McIvor, 2009; Prahalad & Hamel, 1990).

McIvor (2009) studies in the automotive industry indicate that outsourcing facilitates access to state-of-the-art technology and the use of performance contracts. On the other hand, vertical integration allows companies to adapt to unforeseen contingencies and customer feedback to maintain incentives that are more balanced and develop company-specific capabilities. These effects suggest that outsourcing will be associated with higher levels of initial performance, and that vertical integration will be associated with improved performance over the product life cycle, enabling the development of specific capabilities.

In their research, Lin, Parlaktürk, & Swaminathan (2014) conclude that the integration of supplier activities is always beneficial and independent from the competitor's strategy. When supply dynamics establish dominance over demand dynamics (which is the case of the automotive industry), manufacturers choose to integrate backwards, which allows direct control of quality, especially when the return on investment in quality is low due to its high cost of improvement. In a vertical integration decision, the authors state that there is a better quality of the product sold as well as a lower selling price. The main limitation of this model tested by the authors is to use only one supplier and one customer in a duopolistic competition of two supply chains.

2.2.2 Decision based on the theory of transaction costs. The transaction costs theory is based on the premise that one must analyze not only the economic costs of production but also the transaction costs in intercompany operations (Coase, 1937). According to Williamson (1975, 1979, 1983), a transaction cost occurs when a good or service is bought or sold from one company to another in well-delineated processes, surrounded by several sources of inefficiencies as limited rationality, opportunism, uncertainty and complexity, and information asymmetry.

Transaction costs are the expenses that companies face when they buy and sell in the market. Some examples are the process of seeking the best technical and economical option, the preparation and negotiation of contract terms and the control of delivery performance in the required time and quality, among others (Williamson, 1985).

Williamson (1979, 1983) draws attention to the fact that the expansion of company boundaries tends to increase the costs of administrative coordination, reaching a point where, with high levels of coordination costs, the internal execution of activities becomes practically prohibitive. Phenomena such as bureaucracy and isolationism from competitive market pressure are other difficulties experienced (Geyskens, Steenkamp, & Kumar, 2006). In this case, the company can use the external market and obtain the same product or service at a lower cost through an outsourcing movement.

On the other hand, there are situations in which transaction costs with suppliers are high. Williamson (1975, 1985) considers three dimensions that combined indicate the timing of

integrating an activity. The first dimension is the frequency of transactions, indicating that recurring transactions can absorb overhead costs while reducing transaction costs. Another dimension is the specificity of assets; transactions with specific and idiosyncratic investments that were developed for a particular transaction open space for supplier opportunism, resulting in higher transaction costs. In this case, verticalization is suggested as the best solution. The third dimension arises from uncertainties related to the environment before the contract and with the behavior after the contract.

The central issue of transaction cost theory is whether a transaction performs more efficiently within the firm (vertical integration) or by autonomous third parties (market governance) (Geyskens, Steenkamp, & Kumar, 2006).

Dyer (1997) makes an important counterpoint, suggesting that transaction costs do not necessarily increase with the growth of specific investments in one supplier. In his study, the Japanese automakers present high specific investments with suppliers, but still have lower transaction costs than US automakers.

Aspects such as relationship governance and reliability, driven by a greater exchange of knowledge and information, long-term relationships and the possibility of expanding investment return periods, reduce the impact of inefficiencies in a transaction with limited rationality, opportunism, uncertainty and asymmetry of information. The supply chain of Japanese automakers is much smaller, built on a much closer relationship based on trust and the constant exchange of information between Japanese automakers and their suppliers, reducing transaction costs.

2.2.3 Supply chain organization. Fine (1998) argues that the supply chain is constantly changing. This situation makes the study of its dynamics essential to understand and anticipate which competitive advantage, even if temporary, can become an ally for the survival of the company. Fine (1998) proposed a double-helix model: the strategic and operational movements of companies run an infinite cycle, migrating between disintegration and integration. The verticalization and horizontalization of production are dynamic processes that occur over time, in which the competitive forces integrate and disintegrate companies and sectors. The double helix model suggests chain disintegration forces (horizontal and modular configuration) and chain integration forces (vertical and integrated architecture) should drive the arrangement of firms in the supply chain.

Cacciatori and Jacobides (2005) suggest explanations for industries returning to the vertical integration model after long periods of specialization:

- companies seek to protect their position in the value chain;
- look for new markets; or
- find possibilities to leverage skills and offer more value to customers.

These authors also point out that one of the main results observed was that specialization generates a series of specific knowledge over time. For example, intellectual properties created by specific needs and that can be transformed into patents or industrial secrets, serving as powerful bargaining power in future negotiations. This scenario becomes increasingly critical, as technologies evolve rapidly and are available at increasingly affordable costs; information is updated and available at any time; increasingly dynamic and sophisticated markets; and substitute products and new entrees in abundance.

Dynamic analysis of supply chain relationships from the economic, strategic and transaction cost perspective is important but should be analyzed with a thorough understanding of the industry context and its competitors. Therefore, it is necessary to revisit the concepts of "make or buy" in the national automotive industry.

3. Methodology

The research has a qualitative approach, which was conducted herein through multimethod research (Minger & Gill, 1999). Information collected in interviews was used in conjunction with secondary data, clarifying key elements within the scope of the research objectives (Guercini & Runfola, 2008; Minger & Gill, 1999; Yin, 1994).

The context of the research justifies the use of the multimethodology approach and multiphase process: complexity; interrelationship of non-linear exogenous and endogenous multivariable; the involvement of an emblematic sector in the world, extremely competitive and highly globalized; and extreme secrecy of information (Minger & Gill, 1999).

The research comprises five distinct phases:

(1) *First phase*: The first phase of this research sought to understand, map and describe the current structure and architecture of the automotive sector through secondary data focusing on three countries: South Korea, China and Brazil. The authors used information from internal company reports, Anfavea reports and data published on the internet from automakers and suppliers installed in these three countries, thus representing the microeconomics. Information was collected covering different perspectives of these automakers in these three countries: financial, market data and supply chains structure.

(2) *Second phase*: At this stage, we seek to understand the current structure of the production factors in South Korea, China and Brazil through secondary data. Information regarding political, economic, fiscal and other specific aspects of these countries was collected, thus representing the macroeconomics.

(3) *Third phase*: A semi-structured interview script was developed, based on the literature review and findings from the first and second phases to deepen the analysis of the data found herein. The authors' main interest was to understand the structure of the supply chain and how each automaker relates to its first and second level suppliers (Tiers 1 and 2). Six executives representing the automakers from each country selected for this research were interviewed. Each one of these executives has more than 20 years of experience in the automotive industry. Three of them are directors in charge of the supply area, two are vice presidents responsible respectively for the supply and engineering areas and the production area and one is the director responsible for the supply and production area. Two executives work in newly installed automakers in the country, while the others work in traditional automakers in the domestic market. The interviews were conducted by at least two of the authors, with an average duration of 80 min. One of the authors has been working in the Brazilian automotive industry for more than 25 years, with extensive experience in product development and interface with suppliers, which was important for the consolidation of the script and discussion with the interviewees. For reasons of confidentiality, it is not possible to name the automakers interviewed.

(4) *Fourth phase*: Authors conducted a workshop with executives and experts from automakers, automotive suppliers and universities to discuss the automotive industry, held on May 20, 2015, at the auditorium of EAESP/FGV (Escola de Administração de Empresas de São Paulo/Fundação Getulio Vargas). The workshop was entitled "Innovation in the Automotive Sector in the Current Scenario: Challenges for 2015-2018" and brought together 145 representatives from distinct sectors of the automotive industry and academia (Fórum de Inovação, 2015). In addition to the use of general information compiled on the discussions, the workshop was used to gather complementary information to those obtained in the

interviews. Individual discussions were conducted with eight executives that participated in the event. These executives occupied management or board positions in automakers covered in the scope of the research.

(5) *Fifth phase*: In this last phase, we worked on the tabulation of the results and established relationships with theoretical aspects.

4. Results and discussion

First, we tabulated a summary of the analysis of secondary data (first and second phases) and information collected in the interviews with the executives of the automakers and the individual discussions from the workshop (third and fourth phases) (Table III).

Some information from GCI (2016) previously presented in Table II regarding the macroeconomic situation was confirmed: comparatively, Brazil has low basic infrastructure, worse indicators of labor quality and high impact of government actions in the product market (public policies, taxes, science and technology policies). While Brazil has historically stimulated automakers through tax incentives to attract local manufacturing, South Korea and China invested heavily in research and development. These countries are able to generate knowledge at the different levels of supply and the automakers, while Brazil depends on the imports of technology from multinational companies (both automakers and Tier 1 suppliers). Tier 2 has a low level of innovation as most of these companies have a low capacity for investment. As macroeconomics play a major role in the competitiveness of a developing country (Porter & Schwab, 2014), it is identified as a local gap that prevents the development of local suppliers with technological skills.

By analyzing the secondary data, we consider important to compare the financial results of some automakers to discuss their competitiveness. Table IV presents information on the profit margin (profit over net revenue) of some companies operating in Brazil, considering the global result of these companies.

We highlight some trends from the analysis of Table IV.

- American automakers (Ford and GM): have average profit margins around 4 per cent, with standard deviations higher than other companies.
- Japanese automakers (Toyota and Honda): while Honda has presented a stabilized value of around 4 per cent with low standard deviation, Toyota was able to exceed 7 per cent consistently.
- Indian automaker (Tata Motors): a new global competitor with an apparent low-cost strategy, it has a stabilized margin of around 5 per cent.
- Korean automaker (Hyundai): a global competitor that has managed to be present in the main countries and has systematically presented a profit margin superior to all other world competitors, in the range of 9 per cent.
- Chinese automaker (Geely and SAIC): they are new entrants worldwide; while Geely has a profit margin of around 8 per cent, SAIC reached a constant margin of 4.5 per cent, equivalent to the industry's average margin.

Considering microeconomic policies, it is possible to highlight some differences between the characteristics of the traditional industries in Brazil and the newly installed Korean and Chinese industries. The analysis of primary data (interviews, workshops and individual discussions) enabled the gathering of comments and information, and allowed their correspondence with the literature concepts and their comparison in different supply chain structures analyzed herein (Table V). It was possible to compare the same concept from the

Characteristics	Brazil	South Korea	China
Market	4° World Market (2015)	12° World Market (2015)	1° World Market (2015)
Local production	3,802,701 vehicles (2012)	1,534,889 vehicles (2012)	19,306,435 vehicles (2012)
Characteristic of market	Segmented; under crises	Stagnant and small market	Growing market
Brands marketed in the country	27 brands (2015)	Few brands (Korean brands)	More than 130 national brands and JVs
Import	All segments; significant quantities	Small quantity	Small quantity
Export	Mercosur and Asia emergents	High quantities (Europe and USA)	Internationalization policy in progress
Source	*Secondary data*	*Secondary data*	*Secondary data*
Production characteristics	High fixed cost	Medium fixed cost	Low fixed cost
	Instability of demand	Stagnant demand	High local demand
	High level of idle capacity	Low level of idle capacity	Very low level of idle capacity
	Difficulty for investments	Easiness for investments	Easiness for investments
	Difficulty in launching new products	Easiness in launching new products	Easiness in launching new products
Existence of natural resources	High	Low	High
Processing capacity of natural resources	Low	High	Medium - growing
Quality of digital infrastructure	Low - growing	High	Medium - growing
Skilled labor	Low	High	High
Quality of secondary educated labor	Medium	High	High
Basic infrastructure	Low	High	Low - growing
Availability of strategic input	Limited	High	Limited
Tier 1 suppliers: quality and availability	Low	High	High
Tier 1 suppliers: competence and capacity	Limited	High	High
Tier 1 characteristics	Multinational companies	National companies – same corporation	National – same corp. & independents
Relationship with Tier 1	Cost	Equity control	Equity control, State control, or mixed
Logistics costs	High	Low	Low
Transaction costs	High	Low (same corporation)	Low

(*continued*)

Table III.
Summary of research results

Table III.

Characteristics	Brazil	South Korea	China
Tier 2 characteristics	National companies (usually familiar)	National companies	National companies
Tier 2 relationship	None	Partnership	Equity control, State control, or mixed
Public policies influence	High	High	Low (State-owned companies)
Exchange rate impact	High	High	High
Country infrastructure impact	High	Low	High (State-owned companies)
Taxes impact	High	Low	Low (State-owned companies)
Science and technology policies impact	High	High	Low (State-owned companies)
Tax incentives impact	High	High	High (State-owned companies)
Main bottleneck	Political instability	Opening to the external market	Opening to the external market
Source	*Primary data (interviews)*	*Primary and secondary data*	*Primary and secondary data*

Source: Secondary data, interviews and individual discussions conducted by the authors during the workshop

Automaker	Profit margin 2015 (%)	2014 (%)	2013 (%)	2012 (%)	Average (%)	SD (%)
Ford	4.9	0.1	8.1	4.2	*4.3*	*3.3*
Gm	6.4	1.8	2.4	3.2	*3.5*	*2.0*
Toyota	8.1	8.0	7.1	4.4	*6.9*	*1.7*
Honda	2.4	3.8	5.0	3.7	*3.7*	*1.1*
Hyundai	7.0	8.2	9.8	10.1	*8.8*	*1.4*
Tata Motors	4.0	5.3	5.6	5.2	*5.0*	*0.7*
Saic	4.5	4.5	4.4	4.4	*4.5*	*0.1*
Geely	7.2	6.3	8.9	7.9	*7.6*	*1.1*
Fca	0.3	0.6	1.0	0.1	*0.5*	*0.4*

Note: SD = Standard Deviation
Source: Data compiled by the authors from Orbis database

Table IV. Comparison of global profit margins (profit on net revenue)

perspective of each supply chain model, qualifying it according to the perception of the interviewees. Finally, the authors discussed the findings and concepts mapped in contrast with the theory of transaction cost, which enabled the establishment of connections between findings and theory. The discussion of the main findings is below; possible connections with the theory are accomplished when possible.

4.1 South Korea

The interview with the executive of the Korean company elucidated that the structure of Korean automakers follows the chaebol concept, which can be defined as a large business group that is controlled by a family or by members closely related to this family. The government support is common leveraging business growth (Choi, Michell, & Palihawadana, 2008). The main characteristics of a chaebol are centralized planning; the vertical structure of the organization; family shareholding in each business of the chain and high capital investments (Choi et al., 2008; Jwa, 2002). The automotive industry is considered the fifth stage of chaebol evolution, receiving high investments focused on technology development, brand building and channel development (Choi et al., 2008).

The parent company (automaker) interacts with all major Tier 1 suppliers through equity control. These suppliers have autonomy to provide their auto parts to other customers and especially to competitors, thus achieving economies of scale that result in lower costs for the parent company.

The centralized governance in the supply chain provides high reliability between the automaker and its suppliers, providing conditions that reduce transaction costs: the long-term relationship and the possibility of expanding the return on investment of specific assets reduce opportunism; in turn, the greater exchange of information reduces the uncertainty and asymmetry of information, minimizing transaction inefficiencies (Williamson, 1979, 1985; Gulati & Singh, 1998; Dyer & Chu, 2003). Economy of scale and, especially, transaction costs minimization along the production chain are factors that make South Korean companies more profitable than the industry average.

According to the executive of the Korean automaker:

> [. . .] the concept of chaebol is premised on the pursuit of vertical integration with suppliers [. . .] the company has the need to exercise strong control not only over operations but mainly over future developments in technology.

Table V.
Findings from the interviews

Concept	Traditional model	Brazil Modular consortium, industrial condominiums	South Korea	China	Link with literature
Supply chain governance	Medium to weak Bilateral governance – relational contract. Focus on business relationship	Medium Bilateral governance – relational contract. Mostly based on business relationship	Strong Unilateral governance – bilateral contract. Centralized in the automaker (chaebol)	Strong Unilateral governance – bilateral contract. Centralized in the automaker (shareholding control, State or mixed)	Unilateral/unified governance reduces transaction costs involving specific assets (Williamson, 1979, 1985)
Reliability	Medium	Medium to high Physical installation near or inside the automaker gives greater long-term relationship reliability	High Belonging to the same nationality and the same economic group reinforce reliability	High Belonging to the same nationality and the same economic group reinforce reliability	Reliability is an alternative safeguard that reduces transaction costs (Dyer & Chu, 2003; Gulati & Singh, 1998; Williamson, 1979, 1985)
Information exchange	Medium to weak	Medium to high	High Lower number of members in the chain and centralized planning facilitate the exchange of information	High Lower number of members in the chain facilitates the exchange of information	Greater exchange of information reduces asymmetry of information and opportunism, reducing transaction costs (Dyer, 1997; Dyer & Chu, 2003)
Long-term relationship	Medium to long term There is a tendency to prioritize the value of the transaction in the negotiations (decision based on cost)	Long term Physical presence ensures long-term relationship	Long term Belonging to the same economic group ensures long-term relationship	Long term Belonging to the same economic group ensures long-term relationship	The longer the relationship between a buyer and a supplier, the greater the likelihood of consolidating social relationships, generating reliability (Gulati & Nickerson, 2008)

(*continued*)

Table V.

Concept	Brazil: Traditional model	Brazil: Modular consortium, industrial condominiums	South Korea	China	Link with literature
Return period for specific investments	Medium Investment based on specific project, with amortization period fixed by the supplier (usually a minimum period guarantee by contract with automaker)	Medium to High Investment based on specific project, with amortization period fixed by the supplier (physical proximity ensures longer terms)	High Investment based on specific project, with a longer amortization period determined by the automaker	High Investment based on specific project, with a longer amortization period determined by the automaker	Longer return periods on specific investments reduce transaction costs (Dyer, 1997)
Number of suppliers belonging to the Chain	Medium Concentrated on multinationals	Medium Concentrated on multinationals	Low Belonging to the chaebol	Medium to low State control, stock control or mixed control	Lower number of vendors reduces transaction costs (Dyer, 1997)
Competencies of the automaker in auto parts, subsystems, systems and modules	Low Developed by suppliers (third parties)	Low Developed by suppliers (third parties)	High Developed within the chaebol, high investments in R&D and qualified labor facilitated by the macroeconomic policies of the country	High Developed within the supply chain u sing joint ventures with Western companies and government support on R&D investments	Loss of important competencies affects competitiveness (McIvor, 2009; Prahalad & Hamel, 1990)
Intellectual Properties/ Patents for auto parts, subsystems,	High	High	High	High	High volume of Intellectual Properties generates vendor opportunism (McIvor, 2009) - it also generates a force for vertical integration

(*continued*)

Table V.

Concept	Traditional model	Brazil Modular consortium, industrial condominiums	South Korea	China	Link with literature
systems and modules					(Cacciatori & Jacobides, 2005; McIvor, 2009)
	Large majority belongs to Tier 1	Large majority belongs to Tier 1	Large majority belongs to the automaker	Large majority belongs to the automaker	
Economy of scale	Medium Dependence on global projects	Medium Dependence on global projects	High Suppliers under stock control provide parts to other automakers (competitors)	High Due to the production volumes involved (supplier can provide parts to more than one Chinese automaker)	
Supply chain organization	Horizontalization	Horizontalization	Vertical integration with Tier 1 suppliers and eventually Tier 2	Vertical integration with Tier 1 and Tier 2 suppliers	

Source: Interviews

There is a close relationship between the automaker and top Tier 2 suppliers, which are usually companies of the same nationality as the automaker, maintaining a long-term and continuous relationship (Gulati & Nickerson, 2008). They have a specialization characteristic because the automaker invests in specific assets for their use. There is a constant exchange of information between these companies and the automaker, which reduces uncertainties about demand and new developments (Dyer, 1997; Dyer & Chu, 2003).

The local political stability of the country and the public incentives in the automotive industry first focused on making automakers locally competitive and, after a period of maturation of the business model ("chaebolization"), internationally competitive. They replicate their model of operation in the countries in which they operate; for example in Brazil, more specifically in the city of Piracicaba, in the state of São Paulo. They bring together the entire supply structure of companies that are part of their chaebol.

4.2 China

The structure of Chinese companies follows a different arrangement from Korean ones, as it is still a country with socialist characteristics, with strong State control. Companies in the automotive sector are nationalized, as well as a large part of the supply chain, with a solid fiscal incentive and investments in research and development, so that they can develop products of high added value rapidly.

The entire supply chain operates cooperatively with the parent companies (automakers). Both first and second tier suppliers are under control of the automaker (fully nationalized control; mixed control between government and private sector; or shareholder control of the automaker), ensuring a relationship with centralized governance (Williamson, 1979, 1985). The stability of the relationship has ensured high reliability between the automaker and its suppliers, providing conditions that reduce transaction costs (Dyer & Chu, 2003; Gulati & Singh, 1998). Long-term relationships implicate on long-term return on investments in specific assets, thus eliminating opportunism in negotiations between companies (Dyer, 1997). In addition to consistent information exchange, inefficiencies in transactions and consequently transaction costs are minimized.

Western and Eastern (Japanese and Korean) companies, to gain access to the Chinese market, must necessarily constitute a joint venture with a local state-owned enterprise, conducting all steps from project development to full manufacturing internally at the Chinese enterprise, thereby transferring all technology and expertise.

One executive commented that:

> [. . .] the joint venture strategy to enter the Chinese market is very important for the country to absorb technology, learn and develop skills to be in the future with high technology vehicles [. . .] besides joint ventures, I believe that integration with suppliers is very important to gain speed and safety in operations and to consolidate this learning.

There is a government policy focused on technological development in two ways: incentives for investment in research and development and joint venture policy in the country.

The internationalization of the company tries to follow this same model. In Brazil, the main Tier 1 suppliers are Chinese, with state or mixed stock control, ensuring greater stability in the relationship and a verticalization of the supply chain. Chinese companies with shareholder control of the automaker or with state or mixed investment form the layer of the second-tier suppliers, whenever possible. The automakers are constantly close to their suppliers, which indicates information exchange on demand and new developments.

Political stability and government incentives make local firms competitive globally by replicating the mode of operation in the countries where they operate. The

internationalization policy of the Chinese automotive industry is in progress, with companies, for example, settling in Brazil with Chinese Government support and investment.

4.3 Brazil

Brazil has a sui generis automotive sector as it has only multinational automakers. Tier 1 suppliers are also mostly multinational. The choice of these suppliers has a strong dependence on the values of transacted products. There is no shareholder relationship between automaker and suppliers, and there is no participation of the national government in these companies. "There is a strong dependence on Tier 1 suppliers because we have few suppliers with good quality installed in the country [. . .] this hinders the bargaining power," told us a director of a long-established automaker in the country.

> For the most part, the automakers installed in the country depend on suppliers for manufacturing vehicles [. . .] there are no vertical arrangements in the local industry, except for newly installed Korean and Chinese industries, added one of the directors responsible for the supply area in one of the automakers interviewed.

The second tier of suppliers is formed mostly by small and medium-sized domestic companies with family control. Respondents said that this is a weakness of the local industry. It is common that Tier 2 suppliers have financial difficulties, affecting the production of the automaker. Such distancing hinders the exchange of information and knowledge in a fluid way in the chain, negatively affecting transaction costs (Dyer, 1997; Dyer & Chu, 2003).

The creation of local models of the productive chain, such as modular consortium and industrial condominiums, sought to bring the automaker closer to the main Tier 1 suppliers. The modular consortium was implemented by "Volkswagen Caminhões" (trucks) in the city of Resende (Rio de Janeiro State). Industrial condominiums are characterized by the proximity of Tier 1 suppliers, who provide modules directly on the assembly line. Differently, from the modular consortium, the automaker is responsible for the assembly line. An example is the Ford plant in the city of Camaçari (Bahia State). Some of the objectives illustrated by the automakers were to improve the exchange of information and knowledge between the parties, to ensure long-term relationships with suppliers, to ensure a higher return on investment for suppliers, to bring greater reliability in the relationship and to reduce logistical problems. These movements led to lower logistics and transaction costs.

4.4 Discussion

The findings showed that traditional automakers that have been installed for many years in Brazil have a production structure focused on the assembly line with a high level of outsourcing. This outsourcing has led to a dominance of multinational suppliers in Tier 1 over the past two decades due to the lack of competitiveness of the national auto parts industry, a result of the macroeconomic gaps presented herein. All Tier 1 national suppliers either were bought by a multinational company or closed its operations.

Tier 1 assumed the responsibility for Tier 2 suppliers, which are predominantly domestic and family-owned companies with many management problems and unable to cope with the country's frequent economic and political instability. As a result, they generate supply problems, costs and sometimes culminate in bankruptcy. Also, Tier 2 has a low level of innovation. This is a weakness of the traditional automotive supply chains in Brazil pointed out by the research: the detachment of the automakers from their Tier 2 suppliers, which are

much smaller and unable to absorb large variations in demand, has affected the automaker's relationship with Tier 1 and increased costs in the supply chain.

On the other hand, the automakers that settled later tried to adopt different strategies:

- Japanese automakers have brought their consolidated model of relationship with suppliers. There is a long-term relationship with an intense exchange of information, and deep knowledge of Tier 2 suppliers.
- Fiat settled far from the ABC region (São Paulo State), recognized by the strong union activity in the 1980s and 1990s, and developed three fundamental internal activities carried out by companies of the same group: foundry, vehicle body and engine-transmission, avoiding dependence on suppliers in activities considered as competencies.
- Hyundai has been introducing the Korean model in the country, with a strong vertical integration in the supply chain. The company has equity control of suppliers that develop and produce the main auto parts and components. Tier 1 suppliers are part of the chaebol.
- Chinese automakers are building their first factories in Brazil, bringing the mode of operation from the country of origin: automakers and suppliers are companies under the economic domain of the government, with an intense connection between automaker and supplier.

The outsourcing of productive competencies of most Western automakers enabled the development of these competencies in multinational suppliers, driven in recent years by the accelerated advance of information technology, electronics, telecommunications, among other technologies. The benefits of the new technologies are undeniable, but the required levels of investment have been growing at a rapid pace. At the same time, the obsolescence of these technologies happens at a faster rate than the return of the investments, forcing a transfer of investment costs from supplier to the automaker in shorter terms.

Two of the executives interviewed pointed out that the technological developments of suppliers generate several intellectual properties and patents, essential for the development of new vehicles; however, the investment costs in specific assets are passed on to automakers within short periods. Thus, there is an increase in transaction costs between suppliers and automaker (Dyer, 1997), strongly affecting the performance of horizontal supply chains. It is possible to notice there is a pressure from patent holders, which is one of the forces driving a company to consider vertical integration (Cacciatori & Jacobides, 2005).

Companies with a higher level of vertical integration in the supply chain had the best financial results and have been expanding their operations to other countries over the past decade, such as the supply chains controlled by Korean and Chinese automakers. High investments in research and development in these countries, as a result of their macroeconomic policies, support the development of competencies in technology.

To adapt to the new competitive arena, some aspects indicate the need for a change: a globalized and extremely competitive market, new low-cost competitors vertically integrated, new technological skills overlapping traditional ones, heterogeneity of countries regarding economic and political stability and wealth generation.

Based on the results of the research and the qualitative analysis of each concept, we make the following proposition: automakers recently installed in Brazil have lower transaction costs than traditional automakers due to their vertical supply chain structure.

The structural reorganization of the traditional automotive industry in Brazil requires the reduction of transaction costs through the integration of activities upstream of the

supply chain. It is not necessary to follow the oriental models analyzed herein, which are based on intense vertical integration. One cannot affirm, as in the model proposed by Lin et al. (2014), that vertical integration will always be beneficial. However, one can opt for hybrid models, integrating vertically the items whose competence is essential for the company's competitiveness, and outsourcing other items in the market (David & Han, 2004; Williamson, 1991). It is necessary to focus on identifying the necessary competencies to stay technologically up-to-date and at the same time reduce the current problem with the cost pressure of suppliers that hold patents (Cacciatori & Jacobides, 2005). The possibility of moving in the double helix (Fine, 1998), migrating from the current horizontal model to a re-verticalization in the upstream supply chain, will lead companies to focus on their core competencies and reduce transaction costs.

5. Conclusions and final considerations

This research compares the traditional automotive industry installed in Brazil with the automotive industry of two other countries, South Korea and China, recently installed in the Brazilian market and examples of growth over the past decade. The aim is to understand the factors that differentiate the structure and management of the supply chain of the traditional automotive industry in Brazil with those countries, which may pave the way for understanding the problems and for the long-term competitiveness of the Brazilian industry.

In macroeconomic terms, which have a major impact on the competitiveness of the industry (65 per cent according to Porter & Schwab, 2014), it is highlighted by GCI (Global Competitiveness Report 2016-2017, 2016), and it was evident in the findings the importance of solving basic structural problems that keep Brazil trapped in the middle-income trap.

The automotive industry was one of the pillars of the country's rise to the middle-income category in the 1960s. Since then its evolution has slowed down, but one can still find valuable contributions such as the pioneering spirit in the creation of condominiums and modular consortium. The national industry evolved from the assembly of vehicles in the mid-twentieth century to the manufacture of automotive parts and the development of vehicle designs.

However, some negative aspects limit this evolution in the microeconomic scenario, such as high production costs, low productivity, inefficient supply chain, low quality of local suppliers and impracticability of long-term planning because of economic instability; among others.

The focus of this study was to understand which factors lead to an inefficient supply chain in comparison with South Korea and China. The research was carried out through interviews, individual discussions, workshop and secondary data analysis, enabling the identification of the following factors:

- There are few Tier 1 suppliers capable of serving local automakers, mostly with lower qualification and competence than in China and South Korea, reflecting lower quality standards and lower level of competition.
- Tier 1 suppliers in Brazil are multinational companies that have absorbed the responsibility for the development of new technologies. In a context with rapid technological evolution, horizontal automakers are losing the dominance of these technologies to their suppliers.
- Greater technological evolution means a greater level of obsolescence and shorter periods of amortization of investments, which increases transaction costs with Tier 1 suppliers.

- While the traditional automakers in Brazil are far from their Tier 2 suppliers, causing supply and cost problems, the recently installed Korean and Chinese automakers have extensive vertical integration and control of their suppliers.
- Automakers with more vertical integration tend to have higher profit margins.

Given these factors, we conclude that horizontal automakers must rethink the limits of their company and study a plan of re-verticalization, focusing on the parts whose competence is important for their competitiveness. It is an opportunity to identify competencies in automotive parts that have a high impact on cost and especially on rapidly evolving technologies, which, being absorbed internally, can reduce transaction costs and improve quality. This is a practical contribution of this study, which is to encourage managers of the automotive chain to rethink the current management model of the supply chain.

One limitation of the study is the impossibility of asserting the existence of an association between the supply chain organization and the profit margin of the automaker. As the volume of data is small, and there may be other variables in the context, besides escaping from the scope of a qualitative analysis, it is not possible to affirm the existence of a significant relationship between vertical integration and higher profit margin. The authors propose a future investigation using a longitudinal study to investigate this association.

The vertical integration of the upstream supply chain, based on the core competencies and the premise of technological evolution, can be one of the alternatives that can reduce transaction costs, improve the level of quality and dynamics of the supply chain and protect companies from the country's macroeconomic instabilities. The redefinition of new core competencies is fundamental to maintain competitiveness and increase profitability.

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