METHODOLOGY FOR ANALYSIS AND CLASSIFICATION OF ROAD CARGO TRANSPORT MARKETS IN BRAZIL

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ABSTRACT

Alongside a set of external aspects, the structure of a market influences freight charges for Road Cargo Transport (RCT) services, representing more than 60% of cargo transported in Brazil. That makes classifying and analyzing RCT markets essential for transporters and regulators alike. To contribute towards a better understanding of the dynamics of the road cargo transport market, this research work studied the Brazilian Road Cargo Transport industry and proposes a methodology for analyzing and classifying its various markets. The theoretical framework adopted is the Industrial Organization Theory. The results obtained by applying the methodology show distinct situations of RCT market concentrations in Brazil. Furthermore, the main variables associated to such concentrations have been identified, making it possible to establish mechanisms for delineating the profile of the dominant companies in the respective market and to provide supporting information for the structuring of economic and technical regulations.

Key words: road cargo transport, competition, market structures

1. INTRODUCTION

The market is associated to the existence of the opposing forces of supply and demand. The state of equilibrium between them is reflected in the prices. The possibility of there being competition among companies ensures that the prices become adjusted in such a way as to satisfy both seller and buyer of any given product or service. However, not all companies operate in environments where there is a perfect level of competition; some markets are deficient in this aspect. In the latter situations there is only one or a very small number of companies supplying the market and as all of them dominate satisfactory portions of it, there is no effective competition. In that case, price control is in the hands of the supply side and accordingly the conditions are propitious for practicing relatively high prices associated to the reduced supply offer unlike the situation in markets with ideal competition.

To contribute towards obtaining a better understanding of road cargo transport market dynamics, the present paper conducts a study of Road Cargo Transport (RCT) in Brazil and proposes a methodology for the analysis and classification of the various RCT markets in the theoretical framework of the Industrial Organization Theory (Tirole, 1990). The overriding aim is to structure procedures that will enable market participants and those entities responsible for market regulatory actions to enhance their knowledge in regard to RCT and the market where they intend to perform, adapting their actions appropriately and making them more effective.

2. THE RCT SCENARIO IN BRAZIL

In Brazil, transport has been steadily increasing its participation in the Gross Domestic Product (GDP) and in the period from 1985 to 1999 its proportional representation passed from 3.7% to 4.3%. In the period from 1970 to the year 2000 the transport sector grew by 400% while the GDP only grew by 250% over the same period. That strong growth was highly influenced by the geographic de-concentration of the Brazilian economy towards the northern, northeastern and central-western macro-regions of the country that has taken place in recent decades (Fleury, 2003).

Currently, 60% of all cargo within Brazil's territorial borders is moved by Road Cargo Transport (CNT, 2011). An examination of the evolution of the Brazil's cargo transportation matrix shows that little has changed since the 1970s, and Brazil is still highly dependent on road transport.

In Brazil, three kinds of entities perform road transportation activities: companies, cooperatives and autonomous transporters. If the service provision is remunerated then the provider must be duly licensed to perform it (Brazil, 2007), what can only be done by registering in the *Registro Nacional de Transportadores Rodoviários de Cargas* – RNTRC (National Road Cargo Transporters Registration). The register is mandatory for the following categories of transporters (ANTT, 2009a):

- Autonomous cargo transporters (Transportadores Autônomos de Carga - TAC);
- Cargo transport cooperatives (Cooperativas de Transporte de Carga - CTC);
- Cargo transport companies (Empresas de Transporte de Carga - ETC).

2.1 Road Cargo Transporters

The RNTRC establishes a set of minimum requirements for companies, cooperatives and autonomous professionals that wish to register and obtain licensing for the provision of remunerated cargo transportation services (ANTT, 2009a; Cibulska, *et al.*, 2012).

Up until the year 2006, there were approximately 770 registered transporters and by 2008 the number was up to 800 thousand. In 2010, however, the number of registered transporters had passed the mark of 1.2 million. It must be pointed out that 2010 was a year of transition in which new requirements came into force and many previously unregistered

transporters made haste to register themselves to avoid being affected buy the restrictions set out in the new regulations. After the new regulations had been in force for one year, in 2011 the number of duly registered transporters had fallen to 555 thousand. That drastic reduction was an obvious consequence of the rigorous requirements set out in Resolution Nº 3.056/09, which imposed new conditions for entry and stay of carriers in the market related to quality, responsibility and qualification needs for carriers.

The National Transport Regulatory Board (*Agência Nacional de Transportes Terrestres* - ANTT) considered the year 2010 as a year of transition to the situation imposed by the new regulations. By the year 2011 many previously registered transporters found they were no longer able to maintain their registrations (Table I). The drop in the number of registrations was remarkable and in 2011 only half of the registrations that existed in 2010 still existed. In 2012, however, the rate of reduction has slowed down (approximately 8%).

Table I – Reduction in the numbers of registered transporters – 2010/2011

Category	2010	2011	Reduction (quantity)	Reduction (%)
Autonomous	1,078,368	471,165	-607,203	-56.31
Company	206,240	83,678	-122,562	-59.43
Cooperative	735	249	-486	-66.12
Total	1,285,343	555,092	-730,251	-56.81

Source: adapted from GEIPOT, 2010; *ANTT, 2006; **CNT, 2011.

A comparison of the data for 2010 and 2011 reveals that the reduction in the number of registrations of autonomous professionals, cooperatives and companies was over 55% as a result of implementation of Resolution Nº 3.056/09.

2.2 RCT Vehicles in Brazil

In the RNTRC the term vehicle does not necessarily refer only to a vehicle that is capable of transporting cargoes on its own, it also embraces vehicles that are towed by others. As the registration of vehicles is made according to license plates, the statistics informing the numbers of 'vehicles' duly registered with the RNTRC always refers to the number of registered license plates, without distinguishing between self-propelling and towed vehicles.

Currently there are 1.4 million vehicles registered with the RNTRC; more than 50% of them belong to cargo transport companies and less than 1% belongs to transport cooperatives.

In 2011 a reversal occurred in the percentage participations of the fleets of transport companies and the fleet of vehicles operated by autonomous individuals. While in 2010, over 50% of the total fleet of vehicles operating road cargo transportation was in the hands of autonomous operators, in 2011 companies took over that position in the registrations. That is to say in 2011 the companies became responsible for more than half of the vehicle registrations. In other words in spite of the number of autonomous operators' having

remained stable at somewhere around 85 % the fleet of vehicle that they operated was reduced by a considerable percentage.

The reduction in the fleet from 2010 to 2011 was over 30% and the greater part of it was in the fleet of vehicles in the hands of autonomous operators, who suffered a reduction of 40% in the number of vehicles registered with the system. At the same time, the companies also suffered a considerable reduction in their fleets reaching levels of over 20 % of the total number (Table II).

Table II – Reductions in the numbers of registered vehicles – 2010/2011

Category	2010	2011	Reduction (numbers)	Reduction (%)
Autonomous cargo transporters (TAC)	1,141,707	673,341	-468,366	-41.02 %
Cargo transport companies (ETC)	972,808	773,134	-199,674	-20.53 %
Cargo transport cooperatives (CTC)	11,826	10,807	-1,019	-8.62 %
Total	2,126,341	1,457,282	-669,059	-31.47 %

Source: adapted from GEIPOT, 2010; *ANTT, 2006; **CNT, 2011.

The kind of truck bed most used is an open bed, which can be used for the transportation of non specific general or dry cargoes and that means they are flexible enough to permit the transportation of the most varied kinds of products. The percentage of the fleet utilizing open truck bed models is considerable in the case of the companies and cooperatives but in the case of autonomous transporters, it is very high (46.33 %). That shows that the autonomous transporters tend to operate in those transportation markets that do not require a high degree of specialization for freight translocation.

In a similar manner, it can be seen that trucks of the dumper type used to transport earth, sand and other materials with low specific value are widely used by autonomous transporters (answering for 6.17% of the truck bed types). In the case of other more valuable products that demand a greater degree of specialization in their transportation, handling and movement, the cooperative ventures and companies clearly dominate the market in view of the far greater number of specialized trucks in the fleets of those two categories of goods transporters.

3. MARKET ANALYSIS: THEORETICAL FRAMEWORK

According to Tirole (1990), it was Robinson (1960) that originally defined the market as being “the demand for a certain group of goods that are close substitutes for one another”. The theorists of the Industrial Organization Theory subsequently adopted that definition. It is important to establish the difference between company and industry as used by them.

Basically a company stands for a single unit of business, that is, a commercial unit. An industry, on the other hand, is a set of firms or companies dedicated to commercializing the

same goods or goods that are substitutable by one another (Bain, 1963; Guimarães, 1982; Kon, 1999; Santos, 2000, Coloma, 2005; Martins, 2007).

Tirole (1990), who compiled and organized many of the fundamental tenets of the Theory of Industrial Organization and who contributed an analysis of the behavior of companies in a given market (industry), declares that the performance of the supply side, the level of concentration of the market and the extent of the sellers knowledge (information) are endogenous factors and are simultaneously determined by the 'basic market conditions'. According to this author, the endogenous factors may lead to a concentration of the market resulting from the existence in it of relatively large companies with greater power and such a concentration may result in a performance that does not favor a greater number of participants.

In that light, a market would be seen as a form of imperfect competition (with faults) and show itself to be inadequate for achieving greater social benefits because the suppliers have greater capacity for determining prices. Still according to Tirole (1990), the analysis of Industrial Organization is complementary to the analysis of the market structures because it has to do with the efficiency of the market.

According to the precepts of Industrial Organization, nowadays the term market has taken on a broader economic conception and refers to the mechanism whereby buyers and sellers interact, establishing processes and exchanging products and services (Samuelson and Nordhaus, 2004). Thus the market could be seen as associated to the existence of the opposing forces of supply and demand with equilibrium being established between them through the mechanism of prices.

3.1 Economic Theory, Industrial Organization and Markets

Kupfer and Hasenclever (2002) point out that there are various schools of thought in industrial economics, but they can be grouped into two main lines which they refer to as (i) the traditional approach and (ii) the alternative approach. According to those authors the former was structured primarily on the work of J. S. Bain, published in 1940s and 1950s, that gave rise to the Structure-Behavior-Performance model proposed by F. M. Scherer.

More recently the introduction of mathematical formulations in the models and the analysis of interaction among companies have led economists to re-name it New Industrial Economics, which is founded on the studies of Cournot, Bertrand, Nash, Chamberlin, Stackelberg, among others.

The second line of Industrial Economics has been founded on the studies of Joseph Schumpeter and its overriding objective is to study the dynamics whereby the companies produce wealth and less on regulatory aspects that are central to the first. This second approach focuses more on the company and its internal dynamics, taking into account that the different ways in which companies are organized have an effect on the market so

studying them is essential to gaining an understanding of the industrial sectors (Kupfer and Hasenclever, 2002).

Varian (2006) emphasizes two principles that must be considered when analyzing the micro-economics of the markets, namely: (i) the principle of optimization; and (ii) the principle of equilibrium. The principle of optimization is based on the supposition that people choose what they consume in the best possible way according to their budget profiles. It also refers to the optimization of their behavior that companies carry out in order to maximize their profits. The principle of equilibrium is related to the interaction between consumer behavior and the behavior of companies.

In the view of Kupfer and Hasenclever (2002) a company participating in a given market can be seen not merely as an actor in that market but as an actor molded by the actions of multiple actors that participate in that same market. Accordingly, the market may present different structures conditioned by its composition and characteristics.

3.2 Market structures

The structure of a market reflects the way its component elements have been organized, the degree of concentration it presents associated to the sizes and numbers of the participants in it, the differing natures of the products and the conditions for the entry of new participants (Bain, 1963). Hall and Lieberman (2003) define the structure of a market as being: the characteristics that influence the behavior of buyers and sellers when they are conducting their commercial transactions, that is to say, the set of characteristics that influence the commercialization process. Similarly, Troster (2005) states that the structures of the market are models that capture aspects that are inherent to the way the markets are organized.

Varian (2006) defines them as models that describe how companies respond to actions of all the others when they are making decisions on process or production quantities. Samuelson and Nordhaus (2004) recognize two kinds of markets according to whether there is: (i) perfect competition; or (ii) imperfect competition. Those authors characterize the perfect competition market as one where no single company or consumer on its own is capable of affecting the price of the goods. Thus imperfect competition would be when a given buyer or seller has sufficient power to be able to affect the prices in the market on its own.

Melo (2002) explains that in a perfect competition structure there would be no form of coordination among the companies in it whatever. That means companies make their decisions in a decentralized manner and are subject to the market where they are mere accepters of the prices being operated. The same author says that perfect competition represents the most atomized possible state for an industry, the very opposite of monopoly, which represents the most extreme concentration of production. Those two market structures are the basic models of competition in neo-classical economic theory.

Market structures are classified according to their determinant elements and the markets with imperfect competition can be sub-divided according to the characteristics of the companies

involved and their products. The classificatory divisions are monopoly, oligopoly and monopolistic competition (Bain, 1963; Steindl, 1983; Possas, 1987; Rosseti, 2003). Taking into account the structuring elements (number of agents involved, access to information, barriers to entering the market, degree of competition) then the existence of four possible structures can be envisaged (Table III):

Table III – Market Structures - Characteristics

Structure		Characteristics
Perfect Competition		Great number of companies producing very similar goods or services. Each company has a small participation in the market so not one of them on its own has the power to affect the prices being practiced in the market.
Imperfect Competition	Monopoly	A single company controls the sector. No other company produces the same product or service so that the same single company can determine the price in the market.
	Oligopoly	A small number of companies produce the same goods or service. Each one has a considerable participation in the market so that any one of them is capable of affecting prices in the market
	Monopolistic competition	Large number of companies producing heterogeneous products or services but nevertheless, competing with one another for the same clients. Each company has a small participation in the overall market.

Source: adapted from Rosseti (2003); Samuelson and Nordhaus (2004)

4. CLASSIFICATION AND ANALYSIS OF MARKETS

According to Varian (2006), the economy progresses based on the development of models of social phenomena, simplified representations of reality. This author proposes that an economic model tries to describe every aspect of reality but eliminating irrelevant details and concentrating on the essential characteristics of the economic reality it is trying to understand. On the basis of that premise this item will propose a methodology for analyzing road cargo transport markets and classifying them according to their structure and most important characteristics. The data presented are from May 2012 and cover 100% of the carriers and fleet registered in RNTRC in Brazil.

4.1 Measuring concentration

Santos (2000) reports that the degree of concentration, intensity of the competition and the growth possibilities of companies maintain a linear relationship with one another, irrespective of whether the market is regulated or deregulated. Furthermore, in the case of regulated markets, that relation is influenced by the regulatory policy adopted insofar as the public

authorities establish rules designed to control prices, production levels and to some extent, company growth (Martins, 2007).

A classification scheme for concentration measurements, according to Resende and Boff (2002), considers them to be either (i) positive or (ii) normative. Positive measurements portray levels of concentration in the markets by making use of statistical analysis and do not depend on measurements of behavior (of producers or consumers). Normative measurements, on the other hand, use behavioral parameters applied to both producers and consumers.

Those same authors apply other criteria for classifying concentration measurements dividing them into (i) partial measurements or (ii) summatory measurements. Partial measurements make use of data concerning only part of the total number of companies in the market and they are referred to as concentration ratios (CR). Summatory measurements, on the other hand require data embracing all the market participants.

Considering the characteristics of the all the different types of concentration measurements it is possible to conclude that CR and the Hirschman-Herfindahl Index (HH) are the most suitable for measuring market share and concentration in the road cargo transport market.

Concentration Ratio - CR

The Concentration Ratio (CR) is a positive concentration measurement and may be partial or summatory. It is obtained by adding the market shares of the biggest companies in a given industry. The higher the CR value, the greater the power those companies have over the market. The Concentration Ratio CR indicates the market of the k biggest companies ($k = 1,2,..., n$). The higher the CR value, the greater the market power of those k companies. Its value is calculated using the following expression:

$$CR(k) = \sum_{i=1}^{k} S_i \tag{1}$$

In this expression S_i represents the percentage participation in the market of the company i in relation to all the companies operating in the sector. It can be calculated using the following expression:

$$S_i = \frac{X_i}{\sum_{i=1}^{n} X_i} \tag{2}$$

In this case, the variable X represents the available information that makes it possible to measure concentration using a given variable like the turnover or the number of units of production (Martins *et al.*, 2004; Vasconcelos, 2008; Carvalho and Bacha, 2008). In empirical

applications of the expressions the values attributed to k are usually $k = 4$ and $k = 8$. Thus the concentration ratios obtained are shown as CR(4) and CR(8) (Kupfer and Hasenclever, 2002; Resende and Boff, 2002).

The Hirschman-Herfindahl Index (HH)

Another commonly used means of measuring concentration is the Hirschman-Herfindahl Index (HH), which is a measurement classified as positive-summatory type, obtained by adding the squares of the participations of all the companies in the market in question. HH Index provides a broad vision of the market because it takes all participants into account and is therefore more expressive than other market concentration measurements. It is calculated by means of the following expression:

$$HH = \sum_{i=1}^{n} S_i^{\,2} \tag{3}$$

It can be seen that the expression introduces weight structure that is implicit in HH. The act of squaring the value of each partial participation means that greater weight in the expression is attributed to the bigger companies; the higher the HH obtained, the greater the market concentration and consequently, the less competition there is (Kupfer and Hasenclever, 2002; Resende and Boff, 2002).

The value of the HH varies in the interval $1/n \leq HH \leq 1$. The upper limit corresponds to the extreme situation of a monopoly and the lower limit occurs when $s_1 = s_2 = \ldots = s_n$, that is to say, when all the companies in the market are of the same size (Kupfer and Hasenclever, 2002; Resende and Boff, 2002).

4.2 RCT market analysis procedure proposal

One of the aims of an analysis of market structures is to measure the degree of competition in it from the economic point of view. Analyzing that aspect reveals whether there is a need for an intervention in the form of regulatory actions, and also provides useful information to support decision making on the part of economic agents operating in the market analyzed.

The methodology being proposed here consists of four stages and their sub-divisions (Figure 1). Each stage has been structured in such a way as to orientate the analysis making it possible to identify the structure of a given market, evaluate the degree of competition and delineate a profile of the participating companies.

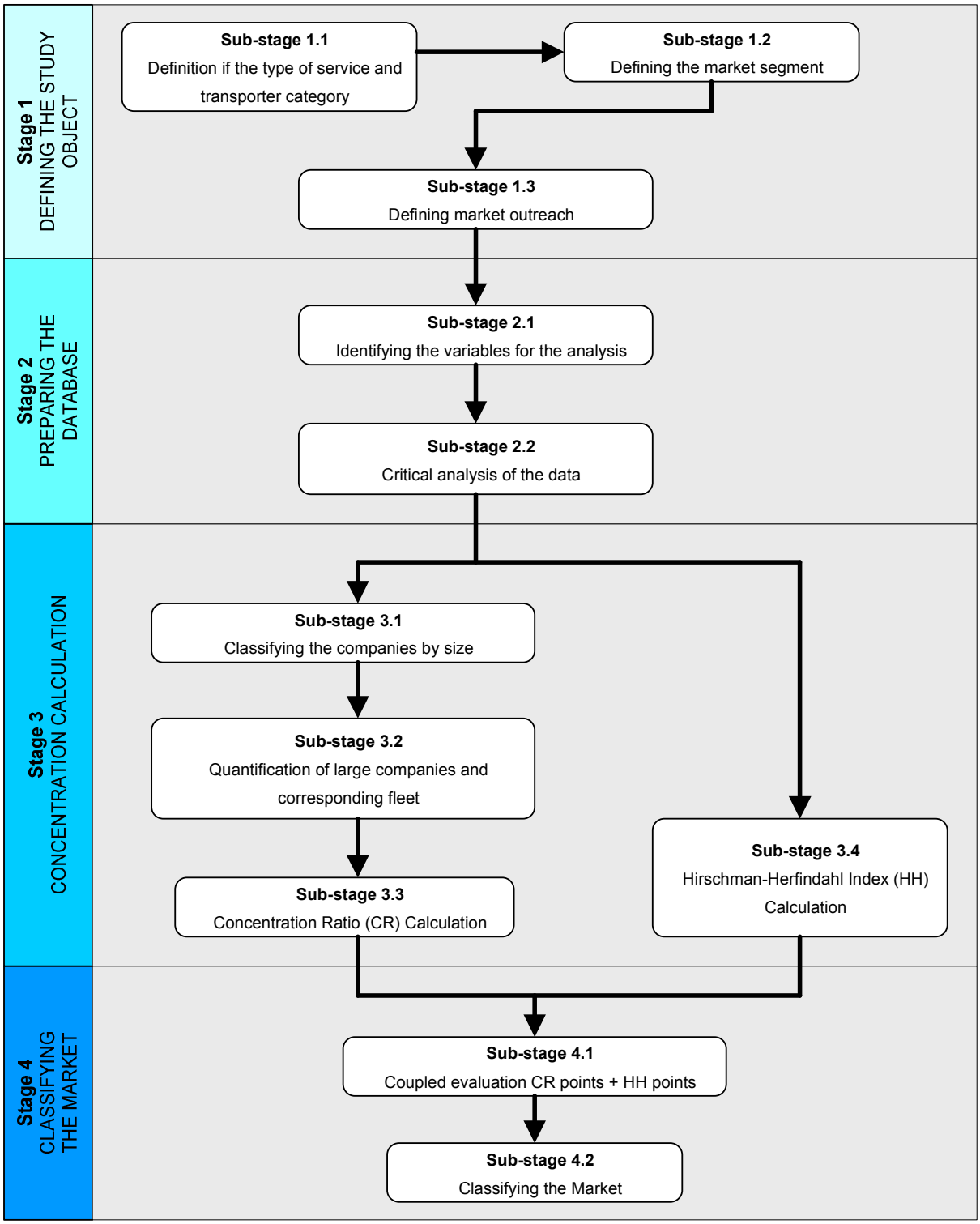

Figure 1 – Methodology for analysis and classification of road cargo transport markets

STAGE 1 – DEFINING THE STUDY OBJECT

From the methodological standpoint, it is necessary to define the analytical section that delimits the market and accordingly the group of companies that will be encompassed by the analysis. Thus the first stage consists of determining the object of study and it is divided into:

Sub-stage 1.1 – Definition if the type of service and transporter category
To characterize a market there must be a commercial relationship involving a client and a transporter. That means that the cargo transportation markets referred to here are those that involve remuneration of the transporters and excludes those that transport their own cargoes. The transporters may be autonomous professionals, transport companies or transport cooperatives.

Sub-stage 1.2 – Defining the market segment
The RCT market can be analyzed globally taking into account the transportation of the most varied kinds of goods. Such an analysis provides a general idea of the how the market is behaving but fails to consider one of the most essential aspects for configuring markets: the possibility of one service being substituted by another. In the case of the RCT system in Brazil that capacity for substitution is intimately connected with the classificatory code attributed to the services in the National Economic Activities Classification System (*Classificação Nacional de Atividades Econômicas* - CNAE).

Sub-stage 1.3 – Defining market outreach
Market outreach is associated to its geographic delimitation. At this stage of the work an analysis will be made of the places where transport companies of this type are installed in the Federal District and an assessment will be made as to whether they compete for the same market. It must be underscored that the outreach here is limited to the company's outreach to clients and not to eventual destinations they are permitted to transport to.

STAGE 2 – PREPARING THE DATABASE

Once the category of transporter, the market segment and the outreach of the study object have been defined, it is possible to structure the database that will be used in the analyses.

Sub-stage 2.1 – Identifying the variables for the analysis
Concentration in transportation markets can be calculated by analyzing the following variables: turnover, profit, fleet, number of employees, volume of cargo transported, cargo carrying capacity, mileage, etc. At this stage primary and secondary data gathering will be carried out to feed the database that will support the analyses.

Sub-stage 2.2 – Critical analysis of the data
This consists of checking for any invalid registrations that could eventually interfere with the results. Things to check for under this heading are duplicated registrations, values that are inconsistent with normal patterns and any other notable inconsistency. This tidying up of the database is important in guaranteeing the consistency of the market concentration results and for the market profile analysis.

STAGE 3 –CONCENTRATION CALCULATION

Two forms of measurement are used to express market concentration: the Concentration Ratio (CR) and the Hirschman-Herfindahl Index (HH).

Sub-stage 3.1 – Classifying the companies by size
In order to proceed to the CR(*n*) calculation it is necessary to define the number *n* of companies whose concentration of the market will be measured in relation to the market as a whole. The *n* companies are those for whom the analysis variable (fleet) is the highest, meaning that they are leaders in their market.

To conduct the concentration CR(*n*) for each segment of the market, companies must be defined and the number of them to be included in the calculation as well. To facilitate that process and according to another Brazilian studies and legislation that explored transportation market, Tedesco (2012) defined five categories of company according to their sizes as can be seen in Table IV.

Table IV – Company categories by size

Category	Size	Categories	Fleet size
1	Large	CAT 1	100 vehicles or more
2	Medium	CAT 2	50 to 99 vehicles
3	Small	CAT 3	10 to 49 vehicles
4	Micro-company	CAT 4	3 to 9 vehicles
5	Individual entrepreneur	CAT 5	2 vehicles

Sub-stage 3.2 – Quantification of large companies and corresponding fleet
Once the size category of all the companies has been completed it is possible to identify the number n of CAT 1 companies, which is the dominant category, and establish the size of their vehicle fleets. Those figures will serve as the base for calculating CR (*n*). For each segment analyzed, the number of leading companies n will be a different number as it will for the total market under consideration.

Sub-stage 3.3 – Concentration Ratio (CR) Calculation
The CR (*n*) is calculated on the basis of the fleet sizes of the leading companies in the market and the figures for the total fleet size. CR figures indicate the value of the *market share* for the leading companies. Using quartile function method, Tedesco (2012) established the following concentration ranges (Table V):

Table V – Concentration as a function of CR(*n*) values

CR(n) range	Degree of Concentration	Points
> 75%	Very concentrated	4
50 to 74%	Concentrated	3
25 to 49%	Tending to concentrate	2
< 25%	Not concentrated	1

Sub-stage 3.4 –Hirschman-Herfindahl Index (HH) Calculation
The Index is calculated by squaring the individual participation of each company and then adding up the squares. In this case, only companies with 2 vehicles or more are considered. Based on an analysis of individual increments and combinatory testing, Tedesco (2012) established the following concentration bands for the HH index (Table VI):

Table VI – Concentration as a function of HH index values

HH range	Degree of Concentration	Points
> 0.3	Very concentrated	4
0.15 to 0.3	Concentrated	3
0.1 to 0.15	Tending to concentrate	2
< 0.1	Not concentrated	1

STAGE 4 – CLASSIFYING THE MARKET

With CR(*n*) and HH index values in hand for the market being analyzed it is possible to classify it as a function of its degree of concentration into:

- Perfect competition market when CR(*n*) and or HH figures obtained are compatible with an absence of concentration;
- Imperfect Competition Market when CR(*n*) and HH figures obtained are compatible with situations of concentration or non-homogeneous markets.

Sub-stage 4.1 – Coupled evaluation CR points + HH points
Once the CR(*n*) and HH values are determined then the sums of the points attributed to the two indexes are obtained and attributed a concentration classification concept for the market (Table VII). If the total obtained by adding the points awarded to the two indexes indicate concentration of the market then the market will be further evaluated in the aspect of the relative participation of the leading companies and the other companies.

Table VII – Determination of the degree of concentration as a function of CR(*n*) points + HH points

Sum of CR(n) + HH points	Concentration
1 to 3	NC
4 or 5	SC
6 or 7	C
8	VC

NC = not concentrated; SC = slightly concentrated C = concentrated; VC = very concentrated

Sub-stage 4.2 – Classifying the Market
Once the degree of market concentration has been determined the market can be further classified according to its structure, that is, whether the form of competition is perfect or imperfect in the form of a monopoly, oligopoly or monopolistic competition (Table VIII).

Table VIII – Classification of market structure

Segment	Concentration	Structure	Type
Homogeneous	NC or SC	Perfect Competition	Perfect Competition *
	C or VC	Imperfect Competition	Oligopoly or Monopoly
Non homogeneous	NC or SC	Imperfect Competition	Monopolistic competition**
	C or VC	Imperfect Competition	Oligopoly or Monopoly

* Indicates that the services provided are homogeneous, that is to say, for a specific cargo segment. Examples of CNAEs in the case of Brazil: 4930-2/03, 5229-0/02, 5250-8/05. 7719-5/99, 8012-9/00.
** Companies that offer heterogeneous transport services but that can be substituted, that is to say, they compete among one another. Applied to companies authorized to transport various types of cargo. Examples of CNAE categories in the Brazilian case: 4930-2/01, 4930-2/02, 4930-2/04.

5. CASE STUDY – MEDIUM AND LONG DISTANCE RCT

The methodology proposed by Tedesco (2012) has been tested in the market formed by companies engaged in inter-municipal, interstate and international goods transport. This segment is the most significant in Brazil and excludes companies that act in urban or short distances cargo transport, which have another regulatory limit. Companies operating transportation of hazardous cargoes have been excluded from this segment as well as those working with furniture removals and other sub-classes of the CNAE registration system.

STAGE 1 – DEFINING THE OBJECT OF THE STUDY

Sub-stage 1.1 – Definition if the type of service and transporter category
Remunerated Road Cargo Transport companies registered in the RNTRC.

Sub-stage 1.2 – Definition of the market segment
Companies duly registered in Brazil with the following code:

- 4930-2/02: inter-municipal, inter-state and international road transport of cargoes except hazardous products or furniture removals

Sub-stage 1.3 – Definition of market outreach
The methodology was applied to all Brazilian states. Data used reference the address record of companies (origin of demand and transport services) and not to the delivery locations. The most significant cases of concentration were found in three distinct outreach configurations which were selected to be shown as a test for the methodology it in different contexts:

- The State of Amazonas (AM);
- The State of Amapá (AP);
- The State of São Paulo (SP).

STAGE 2 – PREPARING THE DATABASE

Sub-stage 2.1 – Identification of the variable for analysis
Data concerning the fleets of all road cargo transport companies registered with the CNAE under code 4930-2/02 in the states selected for market outreach purposes.

Sub-stage 2.2 – Critical analysis of the data
The following steps were taken:

- All registrations were carefully verified to check for possible duplications of the Company tax registration codes or the Vehicle Identification codes in the national system;
- All transporters operating just a single vehicle were excluded (companies in the autonomous professional category);
- All other obvious inconsistencies or invalid values were eliminated.

STAGE 3 – CONCENTRATION CALCULATION

Sub-stage 3.1 – Classification of companies by size
Companies with two or more tractioned vehicles were classified according to their fleet sizes in the ranges established for Road Cargo Transporters. It was found that in the three states that were analyzed, the micro-companies predominate and in São Paulo over half the companies belong to that category.

Table IX – Code 4930-2/02 Companies – Amazonas -AM, Amapá -AP and São Paulo -SP

Fleet size	Size	AM	%	AP	%	SP	%
100 vehicles or more	Large	8	11.6	1	12.5	240	2.9
50 to 99 vehicles	Medium	4	5.8	1	12.5	278	3.4
10 to 49 vehicles	Small	22	31.9	1	12.5	2,209	26.7
3 to 9 vehicles	Micro-company	26	37.7	4	50.0	4,201	50.8
2 vehicles	Individual Entrepreneur	9	13.0	1	12.5	1,336	16.2
Total		69	100.0	8	100.0	8,264	100.0

Source: ANTT (2012) (Overland Transport Regulatory Board)

Sub-stage 3.2 – Quantification of large companies and corresponding fleets
The number of vehicles for each company size category was calculated (Table X). It can be seen that while the category with the greatest number of companies is CAT4, the micro-companies, that is not the category with the greatest number of vehicles.

Table X –Code 4930-2/02 Companies - AM, AP and SP

Category	AM		AP		SP	
	Companies	Fleet	Companies	Fleet	Companies	Fleet
CAT 1	8	4,272	1	101	240	71,985
CAT 2	4	290	1	93	278	18,718
CAT 3	22	477	1	11	2,209	44,537
CAT 4	26	132	4	24	4,201	21,393
CAT 5	9	18	1	2	1,336	2,672
Total	69	5,189	8	231	8,264	159,305

Source: ANTT (2012) (Overland Transport Regulatory Board)

Sub-stage 3.3 – Concentration Ratio Calculation (CR)
Based on the number of vehicles registered for CAT1, the calculation for CR(*n*) was made (Table XI). In the case of the three states that were analyzed the highest CR(*n*) was obtained for the state of Amazonas.

Table XI – CR(n) for Code 4930-2/02 Companies - AM, AP and SP

State	CAT 1 Companies	CAT 1 Vehicles	Total vehicles	CR(*n*)
AM	8	4,272	5,189	CR(8) = 82.33
AP	1	101	231	CR(1) = 43.72
SP	240	71,985	159,305	CR(240) = 45.19

Source: ANTT (2012) (Overland Transport Regulatory Board)

Sub-stage 3.4 –Hirschman-Herfindahl (HH) Index calculation
On the basis of the fleet size information for each company the HH Index was calculated (Table XII). Of the three states analyzed the highest HH index value was obtained for the State of Amapá.

Table XII – HH index for code 4930-2/02 Companies - AM, AP and SP

State	HH index
AM	0.206
AP	0.358
SP	0.002

STAGE 4 – CLASSIFYING THE MARKET

Sub-stage 4.1 – Coupled Evaluation, CR points + HH points
Points were attributed to the CR(*n*) and HH indexes according to the ranges established for each kind of index (Table XIII).

Table XIII – Coupled CR(*n*) – HH evaluation for Code 4930-2/02 Companies AM, AP, SP

State	CR(n)	Points	HH	Points	Sum	Concentration
AM	CR(8) = 82.33	4	0,206	3	7	Concentrated
AP	CR(1) = 43.72	2	0,358	4	6	Concentrated
SP	CR(240) = 45,19	2	0,002	1	3	Not concentrated

The sum of the points shows that road cargo transport markets are concentrated in the states of Amazonas and Amapá while the market in the state of São Paolo is disperse (not concentrated

To give a better idea of the dimensions of the values that were obtained, CR and HH index values were calculated for this same segment of the market in the Brazilian macro-regions and for Brazil as a whole (Table XIV). That was not actually necessary for classifying the markets in the three states that were selected but it served to complement the analysis of concentration distribution in Brazil.

Table XIV – CR and HH values for Code 4930-2/02 Companies – Brazilian Macro-regions and Brazil

Outreach	CR	HH
Center-west	35.37	0.005
Northeast	28.75	0.004
North	38.25	0.019
Southeast	43.46	0.001
South	26.93	0.001
Brazil	35.74	0.000

Thus it can be seen that the states of Amapá and Amazonas have higher levels of concentration than the average for Macro-region North while São Paulo shows values close to the average for its region (southeast).

Sub-stage 4.2 – Market Classification
To finalize stage 4 the markets were classified according to their structures (Table XV).

Table XV – Classification of the markets of the Code 4930-2/02 Companies - AM, AP and SP

State	Concentration	Structure
AM	Concentrated	Oligopoly
AP	Concentrated	Oligopoly
SP	Not concentrated	Monopolistic Competition

In the state of Amazonas, in spite of the relatively high number of companies (69) most of them had a very small participation in the market. In fact, just eight large companies practically dominate the market (82.33 %). The rest is divided among the other 61 companies who have on average a mere 0.3% participation in the market. That is a very different situation from the one in the state of Amapá, which only has eight companies altogether. While the values for the Concentration were not particularly high, the HH index revealed that the market is considerable concentrated. The analysis and evaluation of that market revealed that in spite of there being only one large company in operation, another 2 companies have a significant share of the market and the three together total 90% participation. The other 10% of the market is occupied by the five small companies with an average of 2% each.

In the state of São Paulo, in spite of the relatively high CR value, there is a considerable number (240) of large companies. That being so, the portion of the market for each one of them tends to be small (although the market itself is very big),. In fact, the average market share for each one is 0.2%. That de-concentration was confirmed by the low value obtained for the HH index. The market in São Paulo was classified as one of monopolistic competition because although the transport services offered are not homogeneous, they are competitive among themselves. CNAE category 4930-2/02 includes companies transporting a considerable variety of goods using a diversified vehicle fleet and consequently the companies are competing for the same clients.

6. CONCLUDING REMARKS

If an overall analysis of the Brazilian RCT market is made without breaking it down into the various segments, it gives the erroneous impression that there is no concentration of markets because of the high number of companies in activity. An analysis of the entire set of Brazilian companies and the respective Brazilian fleet shows low figures, CR = 36 and an HH index of 0.0002. However, such an analysis of the aggregated data does not allow for a real assessment of the concentration that occurs in each transport segment. Thus, the methodology proposed by Tedesco (2012) aims to decrease these distortions, analyzing the market from the combination of two indicators of concentration.

Applying the proposed method for classifying and analyzing the RCT markets has made it possible to evaluate the presence of concentration in the markets that were analyzed and to classify the markets according to their structures. It was also possible to validate the stages of the methodology and based on them, by analyzing different segments and different areas of outreach, to verify the occurrence of monopoly, oligopoly and monopolistic competition as well as perfect competition in the various distinct cargo transportation markets.

Complementary analyses were also carried out that can provide support for decision making processes on the part of economic agents engaged in the markets or regulatory bodies associated to them. Such information helps the transporters to position themselves in the market and can certainly be useful to administrative entities in their decision making on markets and the best way to improve the quality of the transport service supply.

Furthermore, good knowledge and understanding of market structure and how it functions can provide valuable support for public programs such as financing the acquisition of vehicles to reduce the average age of the fleet, reducing the taxes on the circulation of certain categories of vehicles, stimulating the acquisition of vehicles with a certain type of truck beds, applying differentiated interest rates or taxes on companies owning a high percentage of their own fleet, and others.

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