UNIVERSIDADE FEDERAL DE JUIZ DE FORA
FACULDADE DE ECONOMIA
PROGRAMA DE PÓS-GRADUAÇÃO EM ECONOMIA

João Augusto Ferreira Freire

The Industrial Organization of Public Higher Education in Brazil: market structure, behavior, and efficiency.

JUIZ DE FORA
2020

João Augusto Ferreira Freire

The Industrial Organizaton of Public Higher Educaton in Brazil: market structure, behavior, and efciency

Dissertação apresentada ao Programa de Pós- graduação em Economia da Universidade Federal de Juiz de Fora como requisito parcial à obtenção do título de Mestre em Economia Aplicada. Área de concentração: Economia

Aprovada em 22 de fevereiro de 2022.

BANCA EXAMINADORA

Drª. Silvinha Pinto Vasconcelos - Orientadora

Universidade Federal de Juiz de Fora

Dr. Marcel de Toledo Vieira - Coorientador

Universidade Federal de Juiz de Fora

Drª. Rosa Livia Gonçalves Montenegro

Universidade Federal de Juiz de Fora

Drª. Camila Cabral Pires Alves

Universidade Federal do Rio de Janeiro

Juiz de Fora, 07/02/2022.

Documento assinado eletronicamente por **Silvinha Pinto Vasconcelos**, **Professor(a)**, em 22/02/2022, às 12:01, conforme horário ofcial de Brasília, com fundamento no § 3º do art. 4º do Decreto nº 10.543, de 13 de novembro de 2020.

Documento assinado eletronicamente por **CAMILA CABRAL PIRES ALVES**, **Usuário Externo**, em 22/02/2022, às 12:22, conforme horário ofcial de Brasília, com fundamento no § 3º do art. 4º do Decreto nº 10.543, de 13 de novembro de 2020.

Documento assinado eletronicamente por **Marcel de Toledo Vieira**, **Professor(a)**, em 22/02/2022, às 14:48, conforme horário ofcial de Brasília, com fundamento no § 3º do art. 4º do Decreto nº 10.543, de 13 de novembro de 2020.

Documento assinado eletronicamente por **Rosa Lívia Gonçalves Montenegro**, **Professor(a)**, em 22/02/2022, às 15:26, conforme horário ofcial de Brasília, com fundamento no § 3º do art. 4º do Decreto nº 10.543, de 13 de novembro de 2020.

A autentcidade deste documento pode ser conferida no Portal do SEI-Uff (www2.uff.br/SEI) através do ícone Conferência de Documentos, informando o código verifcador **0670144** e o código CRC **5B82043A**.

Ferreira Freire, João Augusto.
The Industrial Organizaton of Public Higher Educaton in Brazil : market structure, behavior, and efciency. / João Augusto Ferreira Freire. -- 2022.
135 p.

Orientadora: Silvinha Vasconcelos
Coorientador: Marcel Vieira
Dissertação (mestrado acadêmico) - Universidade Federal de Juiz de Fora, Faculdade de Economia. Programa de Pós-Graduação em Economia, 2022.

1. Economia Industrial. 2. Economia da Educação. 3. Educação Superior. 4. Educação Superior Pública. I. Vasconcelos, Silvinha, orient. II. Vieira, Marcel, coorient. III. Título.

João Augusto Ferreira Freire

The Industrial Organization of Public Higher Education in Brazil: market structure, behavior, and efficiency.

Dissertação apresentada ao Programa de Pós-Graduação em Economia da Universidade Federal de Juiz de Fora como requisito parcial para obtenção do título de Mestre em Economia Aplicada. Área de concentração: organização e mercados.

Orientadora: Profa. Dra. Silvinha Vasconcelos

Coorientador: Prof. Dr. Marcel Vieira

JUIZ DE FORA
2020

Dedico este trabalho a todos os alunos do Brasil, sejam da educação primária, secundária ou superior.

AGRADECIMENTOS

Agradeço em primeiro lugar à minha família, em especial aos meus pais, pelo apoio em todas as minhas empreitadas. Pelas conversas, incentivo, e levantadas de humor, agradeço a todos os meus amigos, principalmente aos mais próximos e que estão sempre comigo. Agradeço, também, à Raphaela, pela compreensão, apoio e torcida intermináveis na reta final desta dissertação.

Sou muito grato, ainda, pelo grupo de amigos que este mestrado me trouxe. Bia, Caio, Daniel, Heloísa, João Vitor, Lucas, Marina, Alex, Claudio e Matheus fizeram cada dia de curso mais engraçado, leve e divertido. Além disso, conversas e debates intelectuais com todos os outros colegas de PPGE enriqueceram ainda mais esta experiência.

À minha orientadora, Silvinha Vasconcelos, agradeço por aceitar me orientar na pesquisa de um tema bastante desafiador. Agradeço pelas reuniões, conversas, debates, cobranças e também pela vibração e apoio nos momentos mais difíceis da confecção deste trabalho. Ao meu coorientador, Marcel Vieira, agradeço pelo olhar clínico e ajuda com a parte empírica do trabalho.

A todos os funcionários do PPGE e aos professores com quem estudei também deixo minha gratidão.

Finalmente, agradeço à CAPES pelo apoio financeiro.

RESUMO

A educação superior é de extrema importância para o desenvolvimento econômico e social. Contudo, características intrínsecas ao produto educação superior, e a consequente ação e presença do Estado no setor aumentam consideravelmente a complexidade de se analisar esta indústria com o arcabouço tradicional da área de Economia. Este estudo almejou analisar a concorrência no setor de educação superior pública no Brasil, com foco em instituições de alta qualidade, utilizando o *modus operandi* de autoridades antitruste ao redor do mundo. Especificamente, empregaram-se técnicas de análise de mercado relacionadas à área de Organização Industrial, baseado no paradigma Estrutura-Conduta-Desempenho, utilizando também o método de modelagem não paramétrica denominada análise envoltória de dados (*data envelopment analysis*) para mensuração da eficiência relativa no setor. Os resultados mostram que instituições de educação superior (IESs) públicas enfrentam pressão competitiva de IESs particulares com qualidade elevada. Ademais, os mercados relevantes apresentam escopo geográfico mais amplo, com uma definição regional ou nacional, a depender da especificação de qualidade das instituições. No geral, os mercados não são concentrados e não geram preocupações anticompetitivas. Dentre as condutas praticadas pelas IESs, identificou-se que os processos seletivos independentes, a diferenciação de produto e a discriminação de preços são as ações mais relevantes e comuns entre instituições. Por fim, a análise envoltória de dados mostra que a eficiência média no setor é alta, com as economias de escala mostrando alta relevância e instituições públicas sendo mais eficiente que as particulares, na média.

ABSTRACT

Higher education is extremely important for economic and social development. However, the higher education product has intrinsic traits that require State intervention in the sector, which hinders the analysis of the industry via traditional methods of the Economics discipline. This study aimed to carry out an analysis of competition in the Brazilian higher education sector, focusing on high quality institutions and using the *modus operandi* of antitrust authorities around the world as a baseline. Specifically, analytical techniques from the field of Industrial Organization have been employed, in addition to the application of non-parametric method of data envelopment analysis to gauge efficiency in the industry. Results showed that public higher education institutions (HEIs) face competitive pressure from high-quality private HEIs. Additionally, relevant markets present a wider scope, with either regional or national range, depending on schools' quality. In general, markets are not concentrated and do not raise anticompetitive concerns. Independent admissions exams, product differentiation, and price discrimination were identified as the main conducts carried out by schools. Finally, data envelopment analysis shows that average efficiency in the sector is high, scale economies are highly relevant, and public institutions are in average more efficient than their private counterparts.

SUMÁRIO

I Introduction

From the perspective of Industrial Economics, the **higher education industry** has not been fully explored albeit this sector plays a major role in the modern economy. Higher education institutions (HEI) educate individuals and contribute to the production and diffusion of knowledge. Their beneficial effects range from contributing to technological advances, providing a specialized workforce, increasing labor productivity, and increasing individual earnings, to improving community engagement and civic institutions. These factors contribute to economic development not only through their direct effect on total factor productivity, but indirectly through positive externalities, in a causality that was brought to the mainstream by Lucas' (1988) and Romer's (1990) endogenous growth models. On these models, knowledge, embodied in human capital,[1] is the factor that allows for sustainable per capita growth.

These positive externalities that benefit not only the person that possesses the knowledge, but also economic agents around them, is a consequence of the public good characteristic of knowledge. This is the reason behind the State presence in the sector, as governments aim to maximize these benefits, since there might not be that great an incentive for providing higher education in the private sector (Stiglitz, 1999). In fact, this is one particularity of the sector that makes it quite tricky to analyze. All around the globe, it is an industry with considerable State presence, with the existence of many public institutions and most non-public institutions being subsidized.[2] There are also private, nonprofit institutions, and private for-profit institutions, all interacting in the same industry (McMahon, 2009; Hansmann, 2012).

Competition in the sector is not traditional, in the sense that it is far from a simple price competition setting. For instance, **public institutions** tend to charge much lower prices, or to provide higher education for free, which is the case in Brazil. Therefore, quality emerges as an important competition variable. The geographical dimension of competition is also key, since proximity might be an important variable on the enrollment decision, depending on the geographical range of a particular institution (Hoxby, 1997).

---

[1] There is a debate in the economics of education literature between the human capital theory and the signaling theory regarding the productivity effect of education. For more information see Blaug, M. (1985). Where are we now in the economics of education?. *Economics of education review*, *4*(1), 17-28; and Arai, K. (1995). The Economics of Education. *Yuhikaku Publishing Company Ltd.*

[2] The subsidies to sectors such as education follow a rationale based on the social return these investments and subsidies yield over the long run. Therefore, the focus is not on immediate financial or monetary return.

It might seem counterintuitive to talk about competition between public institutions, especially since they do not charge any tuition. Nevertheless, public HEIs are competing fiercely for students. Not only amongst themselves but with private institutions as well. Public HEIs might also compete for research grants and other productivity related benefits. Here the focus is exactly on identifying how these institutions compete in a setting where the product price is zero.

Concerning recent trends, it is easy to observe that the private sector has been gaining ground on the public sector in Brazil, even with a considerable expansion of absolute numbers in the public sector (INEP, 1996; 2018). Also, there is a tendency of mergers and acquisitions that create players with elevated market shares, which raises antitrust concerns as have been addressed by the authorities and can be summarized in the merger case concerning Estácio and Kroton.[3]

However, this trend is focused on the lower quality, mass education spectrum of the higher education industry, which has been receiving attention, both in terms of academic works and in terms of antitrust scrutiny. When taking a closer look, the high-quality public spectrum of the higher education industry in Brazil, on the other hand, has not received nearly as much attention as it should – especially from the point of view of industrial organization. There are currently no academic contributions aimed at analyzing the public higher education industry taking industrial organization as the analytical framework. Studying the competitive environment and structure of high-quality higher education, as well as how public institutions determine their conduct as they compete with each other and with private institutions will give a much clearer assessment of the industry.

Being a sector with paramount importance to economic and social development, this study aims to scrutinize public HEIs' competition dynamics under the light of the theory of industrial organization and under competition policy practices. The former provides the basis for analyzing complex markets and the latter adds further contributions to gauge competitiveness in the market.

The main objective here is to draw from a number of analytical frameworks and techniques to devise an analytical framework, based on theoretical landmarks, to **gauge**

[3]Available in the document *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***

competition in the public higher education industry, a sector that is not traditional as a market *per se*. The specific analytical steps needed to achieve this goal are to define relevant markets, to assess market structure, to identify what conducts are more commonly used by players in this setting of strategic interaction, and to gauge the performance in the sector.

Contributing to these areas is a huge step forward towards understanding competitive dynamics in a sector that lacks studies with this scope. More attention is given to the public high-quality sector in developed economies, since public institutions tend to charge tuition, and therefore facilitate analysis. From an analytical point of view, a complicating factor in Brazilian higher education is that public institutions charge no tuition at all, rendering common analytical tools useless. In Brazil, some studies analyze particular aspects of competition, mostly concentration and some performance benchmarks, rarely accounting for public institutions. Others employ a theoretical framework but rarely apply it to the market itself. Antitrust merger analyses are focused on a specific niche of the industry, comprised by the lower quality mass education institutions, and does not provide great insight into competition between high-quality institutions or public institutions. Therefore, the importance of accounting for this relevant market, analyzing it, and of making policy suggestions, especially for a developing country, must not be underestimated.

Just like most studies aimed at a thorough analysis of an industry, here the Structure-Conduct-Performance (SCP) paradigm, introduced by Mason (1939) and popularized by Bain (1959), is used as baseline. It groups the barebone characteristics of industries in an organized manner, providing a framework for the identification of important variables and of the competition dynamics. In fact, it is used to this day in competition policy as the basis for antitrust merger analysis. Applying the SCP paradigm as a tool to understand the competitive dynamics of a regulated service sector can also be considered novelty, boosting the relevance of this work.

Results show that there are many contributions to be made with this dissertation. First, it is important to account for the specificities of such a market. That said, students wish to enroll in the highest quality school their grades allow. So, market definition must be devised according to quality and geography. Higher education undergraduate courses are chosen as focal point for this thesis. It is argued that there are indeed some private institutions capable of rivaling with public high-quality institutions. In terms of

geographic market, the public industry shows a wider relevant market definition when compared with markets made exclusively of private institutions.

This wider range is justified by two arguments: (i) this is an analysis that aims to identify sector-wide patterns and dynamics; (ii) amongst public institutions, the courses offered (which would be different product markets) tend to be very similar. Therefore, three main definitions for relevant markets are proposed in this thesis, with concentration being high in some cases. Nonetheless, it is difficult to assess market power in the sector, since the incentives of public institutions do not include profits.

Second, institutions compete primarily for high-skill students. This has an impact on the competition dynamics of the sector, as it drives players to seek the better students for themselves, instigating conduct actions. HEIs act especially by deploying independent admission processes, differentiating their product by improving courses or specializing the school on a specific area, and by using price discrimination in order to attract the best students.

Finally, performance is measured using data envelopment analysis (DEA) models, with interesting results. Average efficiency is high, but not as high as in previous studies. Economies of scale are shown to be important in the sector, and scale efficiency is shown to be very high. In average, public institutions are more efficient than private, but some big and prestigious public schools present very low efficiency, which raises concerns as to resource allocation.

This dissertation is structured as follows. Chapter II carries out a literature review on the industrial organization literature, analyzing its contributions that will aid in the assessment of the higher education industry, and exposing the DEA model of performance assessment that will be applied later on. Chapter III provides a literature review on the economics of education, its nature as a public good, the incentives to produce it and the benefits that it provides. Chapter IV brings the contributions of papers that analyze higher education, either under the light of industrial organization, or by assessing factors that fit the objectives of this thesis. Chapter V carries out the analysis of Brazil's higher education industry, showing the sector's structure, as well as examining the main trends regarding firm conduct in the industry, with case studies, as well as measuring the sector's performance via DEA. Finally, Chapter VI summarizes the main conclusions of the thesis.

II. Theoretical Basis

The contributions of the economics of industrial organization are applied to analyze complex markets in antitrust processes[4] and in many academic studies (Hoxby, 1997; Baker, 2007b; Becker and Round, 2009; Gideon, 2017; Cruz, 2020), being taken as the best framework to analyze real-world markets without generalizing and attempting to model their characteristics. Therefore, this chapter's central objective is to provide a literature review and explore the analytical tools that are to be used on chapter V, to analyze the higher education industry in Brazil.

The subject of industrial organization emerged because of empirical observations regarding market structure, in the sense that *real markets* are quite rarely perfectly competitive or perfect monopolies, which were the most widespread models of competition in the early twentieth century. That said, the uniqueness of industrial organization is that it utilizes other domains of economic theory as analytical tools, such as microeconomics, econometrics, and game theory, to assess competition in real markets.

Therefore, industrial organization is the field that deals with the theory and empirical evidence regarding imperfectly competitive markets, paying special attention to the reasons why markets might have only a few or many competitors, and how the forces that determine such structure work. The dynamics of the markets, often translated in firms' conducts, and the consequences of imperfect competition are also of utmost importance since they potentially shape market structure and affect consumers (Tremblay and Tremblay, 2012). In the words of Scherer (1970, p. 2):

> "In the field of industrial organization, we try to ascertain how market processes direct the activities of producers in meeting consumer demands, how these processes may break down, and how they can be adjusted (e.g., through government intervention) to make actual performance conform more closely to the ideal."

The chapter is structured as follows: section II.1 focuses on exposing the structure-conduct-performance (SCP) paradigm and its developments, in order to use its framework as the bedrock to chapter IV's analysis, and section II.2 brings the take of competition policy into the discussion, in order to enhance the scope of the assessment.

[4] Used by antitrust authorities in Europe, the U.S.A, and Brazil, for instance.

II.1 The Main Variables of the SCP Paradigm

One of industrial organization's main analytical tools was provided by the **structure-conduct-performance** (SCP) paradigm, first developed by the seminal work of Edward Mason (1939) and popularized by Joe S. Bain (1959). Its development was due to the need of an analytical framework to examine the industrial databases that were being constructed at the time. The analysis was based on the following four industry characteristics: basic conditions of supply and demand, market structure, firms' conduct, and performance. Indeed, performance is one of the main concerns of the field and can be measured by several benchmarks.

The framework of the SCP paradigm allows meticulous assessment of markets' characteristics that leads to inference into its dynamics of competition. It is especially important in the case of this thesis, as the competition process in the higher education industry is not traditional and cannot be measured by price. Therefore, the SCP paradigm allows for a complete assessment of this market, accounting for its many particularities and drawing conclusions from the combination of factors analyzed. Once again, it is useful to stress that there are no works of this scope examining the higher education sector. Therefore, the aim of this section is to present the SCP paradigm and study each of its variables, presenting its more novel contributions, and exploring its possible limitations, in order to lay the foundation to the analysis in chapter V.

Bain (1956; 1959) reaches a causality relation between market structure and firm conduct and, therefore, performance. His work consisted of a cross-section study of 42 industries, 20 being manufacturing industries, upon which there was greater focus. His starting point was a notion that the structure of an industry would determine firm conduct and, in turn, performance. In fact, a given market concentration was pinpointed, above which the profit margins were consistently high over time – that was when the eight biggest firms in the industry had a joint market share higher than 70%.[5]

This notion has been criticized and is now considered oversimplified, but it is interesting to note, however, that the competitive dynamics of a market can be embedded on the market structure – for example, oligopoly, monopoly, or perfect competition are

[5] $CR_8 > 70\%$, in terms of the concentration ratio index.

all structural settings. Nonetheless they translate, to some extent, how competition takes place in that market.

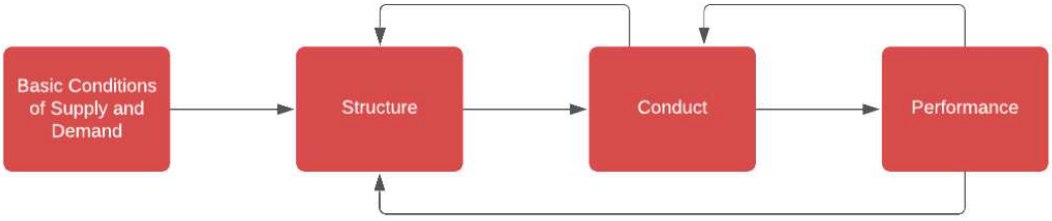
When it came to profit rates, measured by a price to cost margin, the relation was much clearer, since constant elevated profits over time pointed directly to a monopolistic or oligopolistic market structure, characterized by high concentration and barriers to entry, with hindered competition. This was Bain's main contribution, because he was able to demonstrate an empirical correlation between an industry's profit rates and its concentration as well as barriers to entry. With barriers to entry, Bain provided a factor that could explain the existence of imperfectly competitive markets, as seen in real life (Scherer, 1970).

Now, we turn to examine each of the factors that make the **Structure-Conduct-Performance** paradigm: 1) basic conditions of supply and demand; 2) market structure; 3) firm conduct; and 4) performance. The basic conditions of supply consist of any important intrinsic traits of the product that is commercialized in the market, such as the inputs (that is, what resources are used to produce the good in question, how is their market configured and how does that affect the industry in question?), the technology used to produce it (the technical and technological features of the organization of the productive process), its durability, value to weight ratio, as well as the legal and regulatory framework surrounding the product in question, and other traits such as risk and importance to other sectors. On the other hand, the basic conditions of demand consist of the product's price elasticity of demand (a rise in price affects demand in what way?), what are its substitute goods (are the closely substitute goods?), the growth rate of demand, cyclical and seasonal characteristics, buying methods and market types. When combined, these factors are of great influence on the structure of the market, that is composed of the following factors: number of sellers and buyers, market concentration, degree of product differentiation, existence and level of barriers to entry, cost structure (e.g. relevance of scale and scope economies, indirect or direct costs, minimum efficient scale), relevance of vertical integration, and diversification (Bain, 1959). There are many possible actions that one might count as firm conduct, but the main variables of firm conduct can be summarized as such: pricing behavior – predatory pricing, setting fixed prices, price cuts, etc. –, diversification efforts, such as quality enhancement, marketing and propaganda efforts, innovation and research, capacity investments (especially in terms of strategic barriers to entry), and legal tactics, such as intellectual property.

Performance can be interpreted under two perspectives: the firm's and society's. On the firm's standpoint, performance can be measured by profit rates, revenues, allocative and productive efficiency, and market share. In terms of social well-being, performance may take the form of consumer surplus, levels of employment, or even equity (Hasenclever and Torres, 2012).

Figure 1 shows, in a comprehensive manner, how each of the paradigm's components can affect each other. Now each of the main components in the model will be further analyzed, bringing more recent contributions and discussing certain aspects that may be more relevant considering more recent work on the exposed subjects.

Figure 1: The SCP Paradigm's Causalities



Source: elaboration by the author.

II.2 Market Structure

Market structure not only provides the static situation of an industry but can also show the evolution of the dynamics of the sector if one has data for a longer time span. This is particularly useful because we can then assess the shifts in market structure and look for the reasons as to why it has changed. Examples would be the introduction of new products through innovation efforts, firms' conducts, or one might even consider the existence of collusive behavior if market structure is constant for a long period of time.

Market structure usually receives most of the attention when analyzing an industry, since it provides a simple picture of how a certain market is organized. It can also be interpreted according to economic efficiency if one considers certain structures that translate qualitative meaning in terms of allocative efficiency: perfect competition, oligopoly, and monopoly, for example. In fact, considering neoclassical theory, allocative efficiency rises with higher degrees of competition, up to the point of a perfectly competitive market. In reality, that is not always true, and a higher number of competitors does not always follow greater allocative efficiency, with each market's dynamics

needing to be carefully examined. Nonetheless, structures closer to perfect competition are taken as benchmarks of welfare efficiency, and, according to static efficiency, any situation with price above marginal cost is not ideal, generating a deadweight welfare loss[6] (Scherer, 1970).

The first step when analyzing market structure is to define, with precision, the boundaries of the market under scrutiny, which is commonly referred to as **relevant market**. This is commonly referred to as the most important part of an industry's analysis since the entire analytical process is based on the market delimitation.[7] The importance of relevant market definition stems from its effect on the inference of market power. Given a specific antitrust market, defining it more narrowly greatly overstates the potential market power held by firms, and vice-versa. Therefore, efforts must be made to correctly measure the correct scope of relevant markets (Massey, 2000).

An antitrust, or relevant market, is defined as "a collection of products or services, and a geographic region, that would form a valuable monopoly" (Baker, 2007b, p. 133). Thus, there are two scopes composing a relevant market: **product market** and **geographic market**.

Product market refers mainly to the perception of consumers regarding what products are substitutable (demand substitution) based on product characteristics. There is also supply substitution, used more often by European authorities, which concerns the possibility of outside firms entering the market in a timely manner without incurring elevated costs (Baker, 2007b; Elizalde, 2011). However, there is greater focus on demand substitution (Massey, 2000; Baker, 2007).

On that thread, the hypothetical monopolist test is the empirical method usually applied for the exercise of market definition for both dimensions: product and geographic. The test consists of assessing whether a hypothetical monopolist would be able profitably raise prices through a significant but sufficient non-transitory increase in price (a SSNIP between 5 and 10%), assuming a product market and a geographic market definition. If

[6] Statistically significant estimates for welfare loss resulting from market power in the American economy range from 4% to 10% of GNP, depending on the sectors and variables analyzed, as well as the specification of the model. (Scherer, 1970; Daskin, 1991)

[7] Market definition is done through empirical estimations or consumer surveys, and while the vast majority of the literature stands by it, Kaplow (2011) provides a critical study of market definition and argues for its elimination from antitrust procedures.

consumers deviate to other areas or other products, then the scope of test is widened until the monopolist can profitably raise prices (Baker, 2007; Motta and Salgado, 2015).

Other tests that can be applied are cross-price elasticity of demand, price correlations, product flows, and residual demand tests (Massy, 2000).[8] The last test is mainly applied to geographic market definition, that rely on the theoretical basis that markets with lower elasticity of demand enable greater market power abuse (Scheffman and Spiller, 1987). Alternatively – or in a complementary way – consumer surveys or information from players in the market might be used to construct the picture of the relevant market (Motta and Salgado, 2015; Cade, 2016).

The definition of **geographic market** refers to the actual geographical space in which competition takes place for a certain product. For example, the market for perishable goods is probably very local, since consumers will not be willing to travel great distances in search of cheaper perishable goods, since their cost of moving to another location might counterbalance the lower prices. This is explored in the literature as the relation between product price and shipping costs. For example, the market for high-quality higher education might be considered wider than the market for lower quality education, for the simple fact that students are willing to travel longer distances for a better education (McMillen *et al*. 2007).

Therefore, a geographic market consists of the location or region in which consumers take products from different firms as substitutes. For example, suppose that a product from a foreign firm is of similar quality and specifications to that of a local firm. However, the costs of transportation and/or import taxes are too high, greatly diminishing consumers' incentive to buy the foreign firm's product. Thus, the geographic market would be defined as (at least) a national market. This exercise can be done for different ranges of geographic scope to define a geographic market.

In fact, geographic market definition can be quite relevant, especially for services that require the presence of the consumer, like healthcare or presential education since supply is not able to move around geographically. In that case, the geographic market is defined based on suppliers' location, considering that there is no price discrimination on consumer location. Therefore, "identifying the set of market participants", in other words,

[8] For a comprehensive review on empirical tests for market definition, their advantages and disadvantages for each case, see Massy (2000).

which players effectively exert competitive pressure on one another, “is critical for defining the relevant geographic markets (and vice versa)”. To properly identify these players, it is useful to assess whether there is price discrimination based on consumer location. If so, then a starting point to geographic market definition is consumer location – otherwise (if there is no price discrimination) it is supplier location (Elzinga and Howell, 2018, p. 455).

However, antitrust analyses rarely focus on supply-side substitution, with it being more of a complementary factor, and place greater importance on demand-side substitution. One case where it might be relevant is when the production process of different products is similar to the point of allowing firms to seamlessly switch between producing one or the other (Motta and Salgado, 2015). After all, the product must be substitutable for consumers, and this is what most antitrust agencies use when determining relevant markets, since it gives a greater sense of possible market power. This is probably one of the most important parts of analysis, given that a relevant market definition that is too narrow or too broad might not provide a clear picture of the competitive process in a certain market (Baker, 2007b).

It all comes down to how consumers perceive a product in relation to others regarding how similar they are. For example, one might think that all HEIs provide the same product: higher education. Nevertheless, each institution provides a set of courses with varying degrees of substitution between them, and at different quality levels.

At the end, when defining relevant market, one is asking what products are similar enough to limit the possibility of an increase in price. Therefore, a relevant market would be a “set of products (and geographical areas) that exert some competitive pressure over the others” (Motta and Salgado, 2015, p. 64).

P**roduct differentiation** is a defining factor when determining relevant markets, since two products (or services) that appear to be the same – for example, two business administration courses in different institutions – might be seen by consumers as having completely different characteristics, based on some difference in its aspects.

Products may be differentiated regarding **quality**, reliability, design, esthetics, etc. There are two types of differentiation: vertical and horizontal. Vertical differentiation is a clear differentiation in one direction – for example, if the quality of a product increases for all consumers of that product. Horizontal differentiation, on the other hand, is more

subjective – a certain change in the characteristics of a product may be perceived as good by some consumers and bad by others. Product differentiation is quite relevant when defining the relevant market, as has been exposed, but it also gives the producers of a particular product that consumers see as differentiated a certain margin to impose price increases. That is because product differentiation must be analyzed through the eyes of the consumers, and it occurs if consumers perceive two possible products as different. In that case, producers may be able to impose higher prices, because they face a steep residual demand curve (Losekann and Gutierrez, 2012).

The most classical models of product differentiation are Hotelling's (1929) linear city model, Chamberlain's (1933) monopolistic competition model, and Salop's (1979b) circular city model. There is a myriad of conclusions from these models regarding profits, market power and welfare, depending on the model's specifications. For example, Bertrand's and Cournot's models hold their comparative results, with Bertrand yielding more output. However, the Dixit-Stiglitz model of monopolistic competition clearly results in prices above competitive levels, and it increases with fixed costs (Shy, 1995). However, one must remember that "some product differentiation or gradation in quality is permissible within a properly defined market" (Baker, 2007b).

Now, turning to **market concentration,** one can infer as to the competitive dynamics in a market looking at its concentration indexes. A concentration index is a number resultant from an equation aimed at providing a degree of concentration in the relevant market. For example, one can interpret indexes to infer if there is a dominant firm in the market, where there is one firm with most of the market and a competitive fringe of smaller firms, if the market is an oligopoly there are a few firms with large market shares, or if it is close to a perfect competition market, with many firms showing low market shares.

Finally, relevant market delimitation is especially important when calculating a concentration index, because if close substitutes are not considered, then the index will lack in realism and provide biased conclusions (Resende, 1994). Nevertheless, **concentration indexes** are still particularly useful as analytical tools.

These indexes are measured through the market share of firms, which is defined as firm *i*'s sales divided by total sales in the market:

$$\text{ms}_i = \frac{sales_i}{total\ sales} \tag{2.1}$$

Where ms_i is the market-share of firm *i,* $sales_i$ is the total sales of firm *i,* and *total sales* refers to the total sales in the industry's relevant market.

The *n*-firm concentration ratio index (**CR_n**) is defined as the sum of market shares, in decimal or percentages, of the *n* biggest firms in an industry:

$$CR_n = \sum_{i=1}^{n} ms_i \tag{2.2}$$

While it is useful to assess the degree of concentration of a given number of players in an industry, it says nothing about the relative market share of the *n* firms and ignores the market shares of firms outside the *n* biggest firms. Because of that, it does not capture changes outside these biggest *n* firms, such as a mergers, or if a smaller firm is gaining market share (Resende, 1994; Shy, 1995). Remember that Bain's work concluded that a CR_8 higher than 70% showed a positive correlation with elevated profits over time, indicating market power. However, Bain's analysis consists of sector-wide analysis – not that of relevant markets.

Other works[9] tend to use the CR_4 as measure, with benchmarks of possible market power varying around 40% and 60% (Tremblay and Tremblay, 2012). Antitrust authorities do not commonly rely heavily on the CR_n to make conclusions, using it as a starting point for market power assessment, unless the operation constitutes a clear merger to monopoly or merger to a very tight oligopoly. The Brazilian antitrust authority uses a CR_4 of 75% as a filter to assess the threat of coordinated effects in relevant markets (Cade, 2016).

As a matter of fact, the authorities tend to prefer the Herfindahl-Hirschman Index (**HHI**), which provides a fuller picture of the market, since it encompasses all firms (*N*) in the relevant market:

[9] Scherer (1970), Shepherd (1997), and even the Department of Justice and Federal Trade Commission, according to the earlier Merger Guidelines, up until 1982.

$$\text{HHI} = \sum_{i=1}^{n} ms_i^2 \tag{2.3}$$

The HHI ranges from *1/n* (which tends to zero when n approaches a considerably high number) to 1 if expressed in decimals and *1/n* to 10,000 if expressed in percentages, with *n* being the number of players in the relevant market. This index is preferable to the CR_n because it decreases when the total number of firms *n* rises and increases if there are firms with greater market share. Since it is a squared index, it puts greater emphasis on bigger market shares, being more useful when assessing market power. When the HHI is close to zero, it would mean that the market is close to perfect competition, and when the index approaches 1 or 10,000, the market is approaching a perfect monopoly. Therefore, the Herfindahl-Hirschman Index depends both on the number of companies *N* operating in the market and on their relative market shares, with bigger firms weighing more (Resende, 1994; Shy, 1995). One interesting result is that the HHI equals *1/n*, n being the number of firms in the market, when the market is a symmetric oligopoly – that is, when all firms have the same market share (Tremblay and Tremblay, 2012).

In fact, Brazil's antitrust authority, Cade (*Conselho Administrativo de Defesa Econômica*), determines that markets are not concentrated if the HHI is less than 1,500 points, moderately concentrated if it is between 1,500 and 2,500 points, and highly concentrated if it is greater than 2,500 points (Brazil, 2011; Cade, 2016). This notion varies between agencies, but not to a great extent.

The HHI is particularly useful in an antitrust context because, because of its mathematical specification, it puts greater emphasis on mergers and acquisitions and on industries with big players, since the index grows more than proportionately to a growth in a single player's market share (Resende and Boff, 2012). This is particularly useful for inferring potential market power.

Figure 1 summarizes the indexes' specifications and their respective benchmarks of market power inference:

Figure 2 - Concentration Indexes

Index	Description	Specification	Benchmark
Market share	Share of the total market held by a player	$\text{ms}_i = \frac{sales_i}{total\ sales}$	$ms > 20\%$
CR_n	Share of the total market held by the n biggest players	$\text{CR}_n = \sum_{i=1}^{n} ms_i$	$CR_4 > 40\%$; $CR_8 > 70\%$
HHI	Sum of the squared market shares of all the players in a market	$\text{HHI} = \sum_{i=1}^{N} ms_i^2$	Moderately concentrated: $1.500 < HHI < 2.500$ Highly concentrated: $HHI > 2.500$

Source: elaboration by the author.

However useful these indexes may be for inferring market power, concentration does not hold a causal relation to market power. Some industries are clearly more prone to concentration precisely because of their structural characteristics, like for example the presence of economies of scale or a minimum efficient scale, and the technology employed (Scherer, 1970), as has been said before, which calls for caution when assessing any industry only by its concentration indexes.

We must consider the possibility that a firm with a large market share might have arrived there through perfectly legal conduct, for example if its product is more efficient, or of greater quality, or even if its cost structure is more efficient. Also, if barriers to entry are low for the industry in question, it is hard to infer market power from concentration indexes, because potential entrants would probably deter the abuse of market power. The fact that many industries are consistently concentrated and present high profit rates over time is commonly connected with the existence of elevated **barriers to entry**.

This concept is based on a very important variable in competition analysis: **potential competition**, which is the competition for profits between incumbent firms and potential entrants. Bain's (1959) definition of barriers to entry supports that relation in the sense that he defines barriers to entry as a structural situation of elevated costs of entry, stopping an entrant firm from operating profitably upon entrance and, critically, allowing for incumbent firms to earn high profits over long time periods. Put simply, barriers to entry restrict competition from potential entrants that would otherwise exert pressure on incumbent firms.

Some causes for the existence of such barriers are scale economies, sunk costs, minimum efficient scale and absolute cost advantages, in addition to advantages related

to product differentiation, expenses with propaganda or capital requirements (Tirole, 1988; Shy, 1995).

Barriers to entry are separated in two types: structural and strategic. **Strategic barriers to entry** are conducts that firms actively carry out to deter entry, usually making the market seem less lucrative than it potentially is. These conducts are considered anticompetitive moves. These situations are usually analyzed through game theory, with sequential games of entry where firms choose to deter entry or to accommodate entrants based on strategic investment decisions (Salop, 1979a). For example, a large investment in marketing and brand building by an incumbent firm might require that any entrant players make similar efforts to compete, considerably raising costs of entry. On the other hand, an incumbent player might overinvest in plant capacity in order to signal new entries would be met with increasing output, thus reducing profits.

Structural or exogenous barriers to entry usually originate in the existence of sunk costs, but also in demand conditions and legal regulations, all hindering a firm's incentive to start operating in a market because of the market's intrinsic characteristics. The theoretical baseline for this situation is cost theory and economies of scale, more specifically the minimum efficient scale (MES), describing a market in which considerable initial investment is needed to start operating with the prospect of economic profits (Schamlensee, 1981; Tirole, 1988).

For example, the models of limit pricing and contestable markets illustrate that, given the structural condition of an L-shaped long term average cost curve – in other words, a cost function that is decreasing for low levels of quantity and strictly non-increasing for higher output – or the possibility of incurring in sunk costs, there is a limit price threshold, higher than the competitive price and lower than monopoly price, that stops entry and provides positive profits on the long run. Firms might also achieve that by increasing capacity (Spence-Dixit and Stackelberg models) or by forcing a lower price to make it seem like they have high capacity. On the other hand, firms might force prices closer to marginal cost without having high capacity in order to discourage entry at first, and then increase them back to monopoly prices when there is no more threat of entry (Tirole, 1988; Shy, 1995).

Closing the elements of market structure are **vertical integration** – how close players are, in terms of ownership and cooperation, to agents in other parts of their value

chain – and **diversification**, translating the presence of players in other relevant markets. These are particularly important if firms operate in several markets at the same time, or if they have a particularly strong grasp of a certain production chain, because they can then use their ample presence to close certain markets, or to retaliate actions in many markets instead of just one.

This section has treated market structure, focusing on exposing its main elements in accordance with the SCP paradigm. These elements are quite important when assessing an industry's competitive dynamics, but they must not be the main focal point. After Bain's work there have been contributions emphasizing how firm's conducts have the potential to shape performance and, in turn, market structure and its basic conditions.

II.3 Elements of Conduct

Variables of **conduct** translate the *actions* taken by players in a competitive setting. In other words, studying player's conduct is an attempt to understand *competition* itself inside a market, in contrast to a theoretical competitive setting or model. Here, the aim is to identify ways players interact with each other while they attempt to achieve their goals and maximize their target functions. Of course, the basic conditions, structure and even performance might influence these actions, and it is paramount to understand how these causalities work and how they influence the incentives behind players' actions.

The antitrust authorities always highlight that each market must be thoroughly analyzed in search of its specific characteristics, and that the competitive dynamics vary greatly between markets, since a particular variable or condition might shape the entire process of competition. However, it would not be quite useful to explore all possible conduct variables, first because of the specificity of each case, second because that has been done to a greater degree of depth in other works.[10] Here the focus will be on how the SCP paradigm can incorporate this new causality, exposing recent contributions, and focusing on the theory behind the conduct variables explored in chapter four.

The causality extracted from Bain's studies is based especially on data from manufacturing industries through the 1940s and 1950s, which brings a bias of sectors highly dependent on economies of scale and plant size (entailing barriers to entry), perhaps explaining the statistical correlation between profit rates and market structure.

[10] Scherer (1970), Scherer and Ross (1990), part IV of Tremblay and Tremblay (2012), and Motta (2004), etc.

Later work focused on how firms could act to change market structure in their favor and gain elevated profits over time. Therefore, there was a shift in efforts from that view of competition as a picture of market structure to competition as the market dynamics resulting from competitor's actions, best reflected in the evolutionary theory (also commonly referred to as Neo-Schumpeterian) of Nelson and Winter (1982).

Scherer (1970) argues not so long after Bain's seminal work that economies of scale – endogenous barriers to entry – cannot explain elevated concentration for most industries in the US. He emphasizes the post-World War II merger wave, government action, and pure historical chance as major determinants of market structure. Notice that amongst these, mergers and acquisitions constitute a variable of conduct. In most cases, mergers are pro-competitive and driven by both the firm that is acquiring a well as the one that is being sold. Recent evidence suggests that the merger-prone corporations have better results in terms of sales and asset growth. Albeit the buyer's intentions might be that of increasing market power, and "the more effectively competition is working, the less essential mergers are as a source of production scale economies" (Scherer, 1970, p. 136).

In fact, merging is not only a conduct variable and a potential mean of acquiring more market power, but firms can also carry out predatory and exclusionary tactics to reduce rivals' market value with the intention of acquiring them at lower prices (Tirole, 1988).

Game theory's contribution was also paramount in that sense because it stressed the ability of players to act as to change the possible outcome of the game in their favor. It made possible (sometimes) to include some industry characteristics in the game's specification (such as entry deterrence games), bringing a more realistic framework into play. Also, the equilibrium in repeated games formalized by the Folk Theorem (Friedman, 1971) further supported how firm conduct could mold market structure (Fisher, 1989).

The hardships of faithfully representing the competition process through a single framework result from its complexity and from the many forms it might take. Therefore, the discussion regarding the direction in which the causality runs – from structure to conduct or from conduct to structure – arguably has one conclusion: it depends on the specific characteristic of the market under scrutiny.

Market structure, as defined by the technology, can shape the dynamic setting of the industry. Market structure might be stable over a long period of time, and if agents expect it to remain stable, then it may shape firms' conducts. On the other hand, in a context where firms are constantly trying to innovate, market conditions are almost certain to change in the long term. In that case, conduct shapes structure. In fact, this is the most likely scenario, and firms will adopt competitive strategies according to their performance in the past and their expectations of the future, always adapting to demand conditions, capital stock, technology and to the actions of their competitors. This dynamic process is defined as competitiveness[11], which is a function of how firms adapt their strategies to the pattern of competition in the industry (Kupfer, 1992). Obviously, this is highly based on Neo-Schumpeterian economics.

Indeed, integrating this theoretical school with the SCP paradigm imbues the latter with means of explaining the dynamic process of competition from within the firms in an industry. For that, we must turn technological progress into a strategic variable instead of just considering technology as given in the basic conditions of supply, since it can effectively change and shape markets by driving product differentiation, improving quality, reducing costs and even creating new markets, just to cite a few possibilities. Therefore, firm conduct is influenced by firm's routines of innovation, which, in turn, influences the other variables of the model (Lopes, 2016).

This subsection was aimed at addressing the main criticism regarding the classic SCP paradigm, namely that its causality runs from structure to conduct and, therefore, performance. Recognizing that the elements of the model can interact with each other in several ways makes it richer in terms of analytical power, making it a better tool to analyze real markets. It is in these real markets that the antitrust authorities seek signs of the existence of market power, with the objective of maximizing social welfare. In turn, social welfare can be measured via a myriad of tools.

II.4 Performance: Data Envelopment Analysis

There are many ways of assessing performance. The correct way depends mainly on the characteristics of the market in hand. So, instead of reviewing traditional methods

[11] "Competitividade", in Portuguese, according to Kupfer (1992).

for measuring efficiency, this thesis explores Data Envelopment Analysis, applying it in a specification best suited to analyze higher education.

Measuring performance in non-traditional markets is tricky, to say the least. Since efficiency is a concept usually so dependent on profit-maximizing market incentives and on the existence of market prices, it is hard to measure performance and efficiency in industries like education and health services (Johnes, 1992). In fact, in non-profit industries, econometric approaches are vulnerable to specification error. Additionally, such models are not optimal in the case of multiproduct firms, that is, firms that produce multiple outputs. However, the most important fact is that it is difficult to specify a functional form for production in such industries (Johnes, 2006; Costa *et al.,* 2015).

Nonetheless, there are methods that use observable variables to try and measure the unobservable (Johnes, 1992). A method that is widely used in such industries is Data Envelopment Analysis (DEA), popularized by Charnes, Cooper and Rhodes (1978) with constant returns to scale (henceforth, the CCR model), and updated by Banker, Charnes and Cooper (1984) to admit variable returns to scale (henceforth, the BCC model).

Essentially, what these models do is to draw a production possibility set and determine whether decision-making units (DMUs, which would represent firms in a profit maximizing setting) are efficient, relative to one another, based on observed input and output data from a sample of similar DMUs. In fact,

> "DEA is a methodology directed to frontiers rather than central tendencies. Instead of trying to fit a regression plane through the *center* of the data as in statistical regressions, for example, one 'floats' a piecewise linear surface to rest on top of the observations. Because of this perspective, DEA proves particularly adept at uncovering relationships that would remain hidden from other methodologies." (Cooper, Seiford, and Zhu, 2011, p. 2).

Data Envelopment Analysis models stem from Farrell's (1957) efforts into measuring efficiency with multiple inputs and outputs, as well as Shephard's (1970) distance function, which is based on formal relations between cost functions and a corresponding production technology. Under the hypothesis that a theoretical level of efficiency has been reached, these models measure efficiency indirectly from observational data via optimizations. They are not estimating production functions but developing envelopes "relative to observational data form all of the $j = 1, \ldots, n$ DMUs,

with the envelope forming an efficiency frontier relative to *each* firm (= DMU) that is to be evaluated" (Banker, Charnes and Cooper, 1984, p. 1081).

Johnes (2006, p. 274) explains it better:

> "The efficiency of each unit is measured as the ratio of weighted outputs to weighted inputs, where the weights used are not assigned a priori, but are calculated by the technique itself so as to reflect the unit at its most efficient relative to all others in the dataset. In a multi-output, multi-input production context, DEA provides estimates of the distance function (Shephard, 1970) which is a generalization of the single output production function."

In more formal terms, the efficiency scores are consistent with extended Pareto-Koopmans efficiency, according to which a DMU is efficient if and only if it cannot improve its outputs or inputs without worsening some of its inputs or outputs. Additionally, a DMU is fully efficient "if and only if the performances of other DMUs does not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs" (Cooper, Seiford, and Zhou, 2011, p. 3; Farrell, 1957).

That said, we start with the specification of the CCR model (with constant returns to scale). (X_j, Y_j) is the set of observed of inputs and outputs for each DMU, with $X_j = (x_{1j}, x_{2j}, \ldots, x_{mj})$ being the vector of m observed inputs from DMU j, and $Y_j = (y_{1j}, y_{2j}, \ldots, y_{sj})$ being the vector of s observed outputs from DMU j. Once again, the aim is to devise a production possibility set and determine which DMUs are efficiently allocating inputs to produce outputs in that set. The production possibility set T is given as (Banker, Charnes and Cooper, 1984):

$$T = \{(X, Y) \mid Y \geq 0 \text{ can be produced from } X \geq 0\} \tag{4.1}$$

The input possibility set, $L(Y)$, is defined for each Y as:

$$L(Y) = \{X \mid (X, Y) \in T\} \tag{4.2}$$

And the output possibility set, $P(X)$, is defined for each X as:

$$P(X) = \{Y \mid (X, Y) \in T\} \tag{4.3}$$

Then, four postulates are put forward regarding properties of the production possibility set, T:

I) The production possibility set is *convex*: If *(X_j, Y_j)* $\in T$, *j = 1, …, n,* and $\lambda_j \geq 0$ are nonnegative scalars such that $\sum_{j=1}^{n} \lambda_j = 1$, then $(\sum_{j=1}^{n} \lambda_j X_j , \sum_{j=1}^{n} \lambda_j Y_j) \in T$.

II) The *inefficiency* (or *free disposability*, in market and price terms) postulate: (a) If $(X, Y) \in T$ and $\bar{X} \geq X$, then $(\bar{X}, Y) \in T$. (b) If $(X, Y) \in T$ and $\bar{Y} \leq Y$, then $(X, \bar{Y}) \in T$.

III) *Ray Unboundedness:* If $(X, Y) \in T$, then $(kX, kY) \in T$ for any $k > 0$.

IV) *Minimum Extrapolation*: *T* is the intersection set of all $\hat{T}$ satisfying Postulates 1 and 2, and subject to the condition that each of the observed vectors $(X_j, Y_j) \in \hat{T}, j = 1, \dots, n$.

Then, a DMU with a certain combination of inputs and outputs *(X, Y)* is in the set *T* if and only if:

$$X \geq \sum_{j=1}^{n} \lambda_j X_j , \quad Y \leq \sum_{j=1}^{n} \lambda_j Y_j \tag{4.4}$$

For some constant $\lambda_j \geq 0, j = 1, \dots, n$, satisfying the condition that $\sum_{j=1}^{n} \lambda_j = 1$.

The most basic form of the DEA model is a ratio – basically a ratio of outputs to inputs. For the purposes of this work, we are concerned with the output-oriented specifications of the CCR and BCC models. That is explained by the fact that in the higher education sector the input choice of DMUs is usually rigid, especially for public institutions. Therefore, DMUs are usually faced with fixed inputs and must maximize output. Therefore, there is a problem of output maximization. Having presented these considerations, we can build the linear programming problem which constitutes the output oriented CCR envelopment model of DEA:[12]

$$\max \varphi_o + \varepsilon \left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right) \quad subject\ to \tag{4.5}$$

[12] This is one of the many forms of DEA models. For a comprehensive review on its possible forms, see the Handbook on Data Envelopment Analysis, by Cooper, Seiford, and Zhu (2011).

$$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = x_{io} \qquad i = 1, \dots, m; \tag{4.6}$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = \varphi y_{ro} \qquad r = 1, \dots, s; \tag{4.7}$$

$$\lambda_j, s_r^+, s_i^- \geq 0, \qquad j = 1, \dots, n; r = 1, \dots, s; i = 1, \dots, m. \tag{4.8}$$

Where φ is the efficiency of the DMU under scrutiny, and the subscript 'o' indicates that the variable belongs to that DMU, with ε being the infinitesimal non-Archimedean quantity (infinitely small but non-zero). s_i^- and s_r^+ are slack variables. The output orientation of the model fixes the inputs of the DMU and explores the possibility of a proportional expansion of outputs (Johnes, 2006). Then, we have the formal definitions of efficiency (Cooper, Seiford, and Zhu, 2011):

- DMU_o is ***efficient*** if and only if $\varphi^* = 1$ **and** the slacks s_i^{-*}, $s_r^{+*} = 0$ for all *i*, *r*;
- DMU_o is ***weakly efficient*** if $\varphi^* = 1$ and s_i^{-*} and (or) $s_r^{+*} \neq 0$ for some *i* and *r* in alternate optima.

Now, by dropping the third postulate, that of ray unboundedness, the BCC model is developed. It allows to focus on productive inefficiencies at the DMU level, granting it the maximum efficiency score if, and only if, it operates on top of the production frontier, even if the DMU is not operating at its most efficient scale. This also makes it possible to check whether there are decreasing, constant or increasing returns to scale at the point the DMU is operating. Hence, the BCC model is also known as a Variable Returns to Scale (VRS) variation of the DEA model. Its specification is the same as the CCR model, with the exception that it adds the following constraint (Banker, Charnes and Cooper, 1984; Banker *et al.,* 2011):

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad j = 1, \dots, n. \tag{4.9}$$

Together, the constraints operate in the way that the virtual output and virtual input of every DMU must not surpass unity. In the output-oriented BCC model, efficiency is measured as the ratio $E = 1/\varphi$, ranging from zero to one $0 \leq E \leq 1$.

Therefore, DEA constitutes a good solution to measuring the efficiency of *players* in non-traditional markets, especially in higher education. It provides efficiency scores based on observed data, and relative to the other *players* in the market. It also accounts for different orientations regarding input or output, and for variable returns to scale. Now, some papers that apply this method to the higher education sector are presented and their results analyzed.

II.5 Market-power, Welfare and Antitrust

Market power can be defined as a firm's ability to keep price above marginal cost in a lucrative way, which reduces total welfare in the economy (Tremblay and Tremblay, 2012; Motta and Salgado, 2015). Mathematically, welfare is usually measured as the sum of consumer surplus and producer surplus, and any situation that does not constitute a perfect equilibrium between supply and demand (perfect competition) reduces total welfare.

That is so because most of the analysis of market power and welfare is centered around static efficiency, but antitrust authorities have recently recognized the importance of dynamic efficiency, in accordance with the process of schumpeterian competition. In this setting, a firm might practice higher prices in the short run to fund their innovation efforts and provide greater efficiency (and welfare) in the future with better or cheaper products.

The most widespread measure of market power is the Lerner Index. It gauges exactly the margin between the price practiced by the firm and the marginal cost (defined as the derivative of total cost in relation to output), since marginal cost equals prince under perfect competition:

$$L = \frac{p - MC}{p} \tag{1}$$

With L being the Lerner Index, p being price and MC being marginal cost.

Nevertheless, it might be difficult to obtain the data needed to calculate the Lerner Index, especially if dealing with marginal costs, since it is a theoretical concept. Also, if the monopolist – or firms with elevated market power – tend to be less efficient because they face less competition, then the Lerner index underestimates market power (Motta and Salgado, 2015). However, it can also be written as the inverse of price elasticity of demand, $E_p{}^d$:

$$L = \frac{1}{E_p^d} \tag{2}$$

The $E_p{}^d$ is:

$$E_p^d = \frac{\partial Q}{\partial p}\,\frac{p}{Q} \tag{3}$$

With Q being total demand and p price. This is particularly useful because $E_p{}^d$ is easier to estimate in terms of data availability than marginal costs.

Therefore, the index's variations can be interpreted considering both demand and supply factors.[13] It is easy to see that, with a perfectly elastic demand, a single producer would be unable to force any price above the competitive price, and it would be impossible to exercise market power. (Motta and Salgado, 2015)

In fact, if we express the price-cost margin as a behavioral parameter θ, which increases when competition decreases (that is, when p becomes greater than MC) and tends to zero when $p = MC$, and remember that the HHI equals $1/n$ in a symmetric oligopoly, we can get a very useful form of the Lerner Index (Tremblay and Tremblay, 2012):

$$L = \frac{\theta . HHI}{E_p^d} \tag{2.4}$$

This equation expresses that market power increases when: (i) concentration (HHI) increases; (ii) when the price elasticity of demand ($E_p{}^d$) decreases; and (iii) when

[13] See Tremblay and Tremblay (2012, p. 312-313) for the full derivations.

competition becomes less fierce (θ increases). This specification of the index may be quite useful because it uses variables that are relatively easy to estimate and can provide a good picture of competitiveness in the market (Donsimoni *et al.,* 1984; Tremblay and Tremblay, 2012).[14]

Even so, it might be difficult to estimate the index. That is why, based on all the theoretical developments above, antitrust agencies commonly use market shares as a starting point and as a proxy to market power, complementing it with an in-depth analysis of entry conditions, buyer power, and other competitive traits of the market (Motta and Salgado, 2015). Brazil's antitrust authority, *Conselho Administrativo de Defesa Econômica* (*Cade*) dictates that a firm holding 20% of the market raises anticompetitive concerns.

Market power has been measured through the years, commonly through proxies such as concentration and profits. Theoretically, factors that positively affect market power are product differentiation, barriers to entry, competition through quantity, potential competition, and the ability of firms to form cartels (Tremblay and Tremblay, 2012). That last factor depends on the ability of firms to coordinate on a given price, detect deviations from the agreement, and punish these deviations accordingly. Empirical evidence (posterior to Bain's) suggests that the effect of concentration on profits is small and statistically weak, but firms' relative advantages have a strong effect on profits, so does capital stock, as well as R&D and advertising efforts (Schmalensee, 1989; Caves, 2007).

However, these variables must be taken with a pinch of salt. In fact, the 2010 U.S. Merger Guidelines emphasizes that market shares and market structure are only proxies for measuring competition, and not an end to themselves. The trend is to attempt to assess a merger's effects first through a discussion of its potential anticompetitive effects, and then analyze market shares. This method is particularly better when analyzing markets with differentiated products (Baker, 2007b; Lopatka, 2011; Elzinga and Howell, 2018). There is also a connection between market power and efficiency, in the sense that firms that possess market power tend to be less efficient than firms in more competitive settings (Motta and Salgado, 2015).

[14] See Donsimoni *et al.,* (1984) for more on the Lerner Index and ways to calculate market power in an entire market.

Social welfare variations are usually measured through comparative statics, which compares two situations: one with competitive prices and one with higher prices, with firms exerting market power. Then, total surplus is calculated in both situations via the sum of the area above the supply curve – producer's surplus – and the area under the demand curve – consumer's surplus – which gives total surplus. This calculation is trivial and based on many assumptions regarding supply and demand curves, being also present in any undergraduate microeconomics book.

The key point is that the increase in producer surplus resultant from a price that is above marginal cost does not offset the reduction in consumer surplus, generating a deadweight loss in efficiency. Also, the higher the price is above a competitive benchmark, the greater the degree of market power and the deadweight loss, suggesting that welfare decreases as market power increases. This also raises the question of income distribution and Pareto-optimality: that situation with a price higher than the competitive ($p > p_c$) is Pareto-optimal, since it is impossible to improve the welfare of one of the parties (producers or consumers) without reducing the other's – it is a matter of the interests of each group (Motta and Salgado, 2015).

That said, competition policy is concerned with what generates market power and how it affects social welfare. First, not every monopoly or oligopoly is certain to yield and exercise market power. Firms are constantly seeking to innovate to obtain monopoly profits, and that is a perfectly legal way of getting them, just as making efforts to increase efficiency, etc. Therefore, competition policy is concerned with situations in which firms obtain market power by carrying out anticompetitive actions, or when they exercise that market power. It is also important to note that competition policy tends to favor the maximization of consumer welfare, putting greater weight on it over producer welfare.

Finally, the antitrust apparatus can act in two ways to suppress the abuse of market power: *ex-post* and *ex-ante*. Ex-post action regards situations where there has been an abuse of market power, via an anticompetitive action by one or a set of players in a market. In that case, competition policy will act to stop the anticompetitive practice and will punish the player that carried it out. Ex-ante action concerns the merger review scope of antitrust. When assessing the effects of a merger or acquisition, the authorities must perform a competitive analysis of the market aiming at determining if this merger can potentially hinder the dynamics of competition. This is why the antitrust authorities' analyses of mergers and acquisitions can be quite helpful when analyzing an industry.

This chapter has exposed the theoretical foundations of industrial organization and competition policy that will be used as the foundation in Brazil's higher education sector analysis in chapter IV. Bain's SCP paradigm will be used to outline the general structure of the market, and additional contributions from industrial organization as well as competition policy will provide a more modern quality to the analysis. Now we turn to exploring the characteristics of higher education that make this sector so peculiar when compared to traditional industries.

III Higher Education: a Market of Imperfect Competition

Higher education's central contribution to society revolves around knowledge. Specifically, in how the industry contributes to the production and diffusion of knowledge through education and research, and its subsequent effects in the economy, either through direct application in technical processes or through its benefits in individuals' lives and on society. Therefore, the **higher education *good*** takes much of its traits from the characteristics of knowledge itself. This chapter explores how knowledge is seen as a good under economic theory, the incentives underlying its production and diffusion, and its effect on society.

The chapter is structured as follows: section III.1 introduces knowledge as a public good and exposes the difficulties in analyzing it under traditional economic theory, connecting it to higher education, and section III.2 explores higher education's contributions to the individuals that acquire it and to society, with section III.3 explaining and arguing for the presence of the State on the industry.

III.1 Knowledge as a Public Good

Externalities and public goods have been widely recognized as important market failures and have been heavily studied in the domain of economics. Nevertheless, there are still some of those goods that raise questions and present certain analytical hardships if one takes a closer look, and knowledge is arguably one of those – especially knowledge produced and diffused in Higher Education Institutions (HEI). In both main spheres of HEI activity – education and research – externalities are present and are caused by the fact that the social rate of return of these activities tends to be higher than the private rate of return. Therefore, this section carries out a brief literature review on the economics of public goods and externalities, pointing out how knowledge fits into that scope.

Samuelson (1954), who was a pioneer on the subject that is now quite widespread in the economics literature, wrote a short article defining two types of goods: private consumption goods (common goods subject to market forces) and *public goods*. One of the two main features of public goods, as put forward by the author, is that "each individual's consumption of such a good lead to no subtraction from any other individual's consumption of that good" (Samuelson, op. cit., p. 387), which is the definition of non-rival goods.

This translates into economic language as a good that has zero marginal cost of production. Under perfect competition, price equals marginal cost. Therefore, the fact that a good is non-rival implies that its price under perfect competition would be zero. Hence, it means there would be no private incentive to provide those goods in the first place (Stiglitz, 1999).

What usually comes with a price are the efforts to acquire and transmit knowledge: "to acquire and use knowledge, individuals may have to expend resources – just as they might have to expend resources to retrieve water from a public lake." (Stiglitz, 1999, p. 309). **In the case of knowledge and higher education**, there is first the effort and need to acquire the necessary "absorptive capacity", or the skills necessary to learn a certain type of knowledge. Second, there are the costs of transmitting such knowledge – in other words, the costs of **diffusing knowledge through the provision of higher education** – translated on teacher compensation and expenses with infrastructure, for instance.

Non-excludability, on the other hand, poses that there can be no restrictions as to who can use the good. Here it is useful to separate knowledge into two types, according to Polanyi (1958): codified and tacit. Non-excludability upholds for codified knowledge, which is easily transmitted in systematic language, constituting a good part of what is taught in universities, such as mathematical theorems, sequence of genomes, etc. On the other hand, tacit knowledge is acquired mainly through experience. It is also sometimes defined as know-how and commonly associated with production processes by the economics literature, although it can be associated with other settings. It commonly presents a specific applied use – hence the elevated tendency to patent. (Polanyi, 1958)

Therefore, knowledge is a public good that produces positive externalities, meaning its social return is greater than its private return. This, coupled with the fact that it is a non-rival good, dampens the private sector's incentive to produce it. Also, while

whomever has the necessary skills to understand a certain piece of knowledge can obtain it, this act of acquiring such skills is costly, and so is the transmission of knowledge through teaching. Starting with the externalities, these characteristics of knowledge and higher education will now be further analyzed.

The importance of studying the higher education sector comes from the positive effect it exerts on individuals, society, and economies. As this sector produces knowledge, its most studied effect is on productivity through its human capital enhancement effect. Taking McMahon's (2009) definition of human capital, we have that "human capital is the *knowledge*, skills, and attributes acquired *by investment in education* and health" (p. 41, emphasis added), as well as family education at home, and on the job training and learning, having positive effects mainly on productivity and earnings.

It is important to note that this effect on productivity spills over to society, since it is argued that one worker's increase in productivity augments the productivity of other workers as well:

> "The worker's educated attributes (knowledge and skills) may spill over to other workers who did not contribute to the cost of the education, helping to enhance their productivity and thereby augment the economic returns to the firm." (Marginson, 2011, p. 416)

Turning to the effects education has on the individual, such as employment and compensation, the OECD's Education at a Glance Report (hereafter, *Report*) provides useful insight. First, higher levels of education enhance participation in the labor market in most OECD countries and partners, as well as reducing the levels of long-term unemployment – more than 12 months unemployed.

In Brazil, the Report shows that employment for adults between the ages of 24 and 35 are of 62% for individuals with less than a secondary education, 73% for those with secondary education and 85% for those with higher education degrees (OECD, 2019). Nonetheless, it is worth noting that the total population with at least a bachelor's degree or higher is low (21%) compared to the OECD average (44%) as well as the parcel of the population with no upper secondary education (32% in Brazil *vs.* the 15% OECD average) which might pose structural difficulties in terms of economic growth:

> "people with the lowest educational qualifications have lower earnings […] and are often working in routine jobs that are at greater risk of being automated, therefore increasing their likelihood of being unemployed (Arntz, Gregory and Zierahn, 2016[1]). These disparities in labour-market outcomes can exacerbate inequalities in society." (OECD, 2019, p. 65)

The average earnings in Brazil for individuals with tertiary education is almost three times the average earnings of individuals with a secondary education (Alves, 2019; Ferreira, 2020). This reflects the inequality highlighted by the quote above: there is a shortness in supply of specialized labor, and it impacts the country's higher inequality rates when compared to members of the OECD.

Although the existence of monetary benefits (most often higher earnings) is widely studied and measured, there are many benefits, like the spillover effect on productivity, that are hard to measure, some of them spilling over to the community and to society as well. These are called **social benefits**, which contrast with private benefits. HEIs play an important role in diffusing these "less traditional" type of benefits as well (Shaker and Plater 2016b).

Thus, higher education results in monetary, directly observable benefits, such as increased employment and earnings, as well as social benefits that are hard to observe, such as higher life expectancy, increased community engagement and civic participation. However, as high as social benefits might be, they do not yield financial returns to the higher education institutions, private for-profit institutions tend to focus on activities and courses that do provide greater returns. However, the *mission* of private non-profit and public institutions differs from for-profit's, as the former aim to advance society's interests and development (Weisbrod *et al.,* 2008). Enter the public sector.

III.2 The Public Sector in the Higher Education Industry

The fact is that the incidence of externalities generating market failures are at the center of the economic argument defending public intervention on the higher education industry: first, there is the lack of information regarding non-market benefits and the elevated social return on investment and its spillover effects; second, the appropriability problems of the knowledge commonly produced by HEI, which entails a lack of direct market returns for knowledge in some areas, such as human and social sciences.

The impact that human capital and knowledge externalities have on the economy simply cannot be understated, and all sectors that generate these externalities have government players acting inside them. More specifically, when the core activity involves human capital training, as is with the education sector in general. In fact, one can argue that any supposed inefficiencies coming from public sector interference are counterbalanced by the positive externalities it generates (De Fraja, 2009).

Essentially, different ownership types operate according to incentives. The private for-profit sector responds primarily to profits, while the public and private non-profit sector respond primarily to their mission of providing quality education and wide access (Weisbrod *et al.* 2008).

In principle, as well as in terms of economic theory, selling education having profit as the sole goal defeats the purpose of education and its public good characteristic. This is not to say that private for-profit HEIs have no place in the industry, because it is simply not true. The point is that their actions must encompass the public good and contribute to the benefit of society. There is room for these institutions, as they operate mainly in mass, lower quality market-oriented education, which provides higher profit rates (Dias Sobrinho, 2013) – with exceptions, of course.

However, it is quite common that private for-profit institutions offer too many products at high tuition fees for those who do not actually need them but end up buying them anyway – which serves only the profit purpose (Hansmann, 2012). Therefore, if socioeconomic goals such as reduction of inequality are to be achieved, the public sector must play a dominant role in this industry (Williams, 2016).

Finally, McMahon (2009, p. 12) contributes as he refutes the efficiency argument with economic theory, highlighting that HEIs' mission is not of profit maximization and encompasses other factors:

> "There is, however, little attention given to defining what economic efficiency in higher education really means, and then using the term properly. Instead, the term efficiency is thrown around with wild abandon. Efficiency includes the externalities involved in serving the public good. That is, it includes both internal efficiency (related to unit costs) and external efficiency (how well the outcomes relate to social benefits expected by society). Economic efficiency therefore requires a balance in the degree of privatization that is optimal. Some is essential, but carried too far the interests of the greater good and future generations can be in jeopardy."

Not only that, but externalities are not the only peculiarities inherent to education that call for state intervention. There are also concerns – which will be further explored in the next chapter – regarding information asymmetry and exercise of monopoly power. The information problem in the sector refers to the difficulty students have of observing characteristics and the general quality of a course in an institution, which hinders the decision process. The possibility of exercise of monopoly power, due to the

characteristics of the sector, forces governments to promote tight regulation in the sector (Teixeira *et al.,* 2004).

Certainly, specific market failures must be connected to specific types of regulation to be efficiently dealt with. For example, "the regulation of market structure includes financial and legal requirements, infrastructure requirements, and requirements relating to staff and programmes" (Jongbloed, 2004, p. 110). Regulation of conduct on exercise of monopoly power, on the other hand, requires *ex-post* action by antitrust authorities, with *ex-ante* action in the form of merger review being deployed to check concentration and incentives in the industry.

Therefore, the mission of HEIs might not be to promote profit, but usually to advance knowledge in society. Theory suggests that there are many characteristics of the higher education industry that can hinder the proper operation of 'traditional' markets, such as the public good characteristic of knowledge and its externalities, the information asymmetry permeating the sector, and concerns of exercise of monopoly power. Thus, around the globe, these market failures are answered with public investment and, sometimes, public provision of higher education. This way, the social return of education is favored in detriment to the private return, as governments aim at providing quality education and advancing social causes when the private sector does not have the proper incentives to do so. The one topic of literature review left to be exposed is how HEIs interact with one another in a competitive setting.

III.3 Competitive Strategies in a Higher Education Mixed Oligopoly Market

Important starting points to understanding competition in the public higher education sphere are the mixed oligopoly model of competition – mixed in the sense of 'firm' ownership: public or private (Cremer *et al.,* 1991; Cremer and Maldonado, 2013) – and the two-good framework, in which firms produce two goods: their mission good (or their objective good), and revenue goods, that support the production of mission goods (Weisbrod *et al.,* 2008).

The defining aspect of a mixed market, in general, is that the objective function of at least one of the firms differs from the objective functions of others. Specifically, public firms tend to aim at maximizing social welfare or total surplus, rather than profits (De Fraja and Delbono, 1990). In some cases, a public firm maximizing welfare can check (or even capture the entire industry demand) a private firm that is seeking to restrict

quantity and raise prices (De Fraja and Delbono, 1987) – in fact, the price that maximizes social surplus is lower than the price that maximizes profits.

What is clear from the early work on mixed oligopolies is that "the public authority can fruitfully use the public firms as an instrument towards the achievement of its goals, namely the increase of social welfare" (De Fraja and Delbono, 1990, p. 14).[15]

A mixed oligopoly model for **differentiated** products was developed by Cremer *et al.* (1991) using Hotelling's model as baseline for a setting in which firms are horizontally differentiated according to ownership, being either private or public. In this mixed oligopoly[16] model, firms are **spatially competing** and choose their location according to the maximization of their target functions: profits for private firms and social surplus for public firms. Authors find a subgame perfect Nash equilibrium for markets with up to 30 firms.

Results are very interesting in the sense that the presence of the public firm increases social surplus in the vast majority of cases, given that it is optimally located. Increasing the number of public firms in detriment of private players also raises social surplus (Cremer *et al.,* 1991). Analyzing a model of mixed oligopoly with differentiated products, Haraguchi and Matsumura (2016) find that price competition always produces higher welfare than quantity competition.

In effect, a mixed oligopoly setting in higher education is also regarded as beneficial for consumers since it increases surplus. Romero and Del Rey (2004) model a setting of competition between private and public HEIs and find that while the quality of private institutions is lower in general, they offer lower cost courses and allow more students to get a tertiary degree, while public institutions keep high quality and admission standards and use selection exams as an efficient allocation tool, in contrast to prices.

Another useful tool to assess the higher education industry is the **two-good framework** (as presented by Weisbrod *et al.,* 2008)[17]. According to it, HEIs can produce mission goods and revenue goods. Institutions produce their mission good – usually

[15] For a comprehensive review on the mathematics behind these models, see De Fraja and Delbono (1990) and De Fraja (2009).
[16] Cremer et al. (1991) is chosen here because he later applies his model to the education sector in Cremer and Maldonado (2013). Nonetheless, earlier work on mixed oligopoly can be found by De Fraja and Delbono (1988; 1989; 1990).
[17] The entire section on the two-good framework is based on Weisbrod *et al.* (2008)

teaching and research – and fund it through revenue goods production – charging tuition, seeking donations and government subsidies, applying for research grants and partnerships with the private sector etc. Different missions require attention to costs all the same: "all types of schools seek profitable activities – though for different reasons. For some schools it is to satisfy investors. For other, traditional schools, it is […] to finance unprofitable mission goods" (*op. cit.* p. 76). This is a very important aspect of this industry's dynamics, since it provides insight into different incentives on how institutions act (their conduct) based on ownership structure.

In terms of incentives, the first point to be made is that HEIs are in competition with one another, irrespective of their ownership structure. **They compete mainly for students** (and for geographic locations to attain students), for teachers and other inputs as well, but in a lesser extent for other sources of revenue, such as donations and research grants. And while the provision of higher education possesses great social value, it is quite expensive and most of the times unprofitable; therefore, institutions must find ways to support their mission activities with revenue generating activities.

An easy way to separate mission from revenue goods is to ask whether the activity would be carried out if it was clearly unprofitable. If the answer is 'yes', then it is clearly a mission good. Mission goods are usually institutions' social goals, such as teaching, basic and advanced research, and public service. These are somewhat hard to gauge as performance measures, with rankings, number of applicants, and share of admitted applicants being the usual proxies.

In fact, public, non-profit, and for-profit schools can be very similar in their actions and revenue seeking activities as well as mission good production. For example, they all engage in advertising and marketing tactics to compete, as well as are cost-conscious in order to either advance mission goals or increase profits, in addition to other relevant actions – as long as a particular conduct does not hinder their mission good activities. On the other hand, pursuing more revenue activities might raise funds to allow further production of mission goods, and so might cost cutting activities.

However, it is clear that:

> "the for-profit sector of the higher education industry is involved in a considerably narrower range of activities than the nonprofit and public sectors. They specialize in activities with clear connections to job opportunities in fields such as business, education, technology, and allied

> health, foregoing unprofitable basic research" (Weisbrod *et al.,* 2008, p. 75).

The bottom line is that independent of ownership, institutions act similarly to pursue their mission, engaging in conducts to raise revenue that might vary according to their specific mission, but always being cost-conscious.

IV The Higher Education Market

This chapter aims at exploring any contributions to the analysis of the higher education industry that will be useful to better understand the dynamics of competition in Brazil. The shortcoming of works analyzing markets in which there is no effective price competition hinders one's ability to draw from source material. Nonetheless, there are logical and empirical arguments being constructed to properly tackle this task, and some of them are described here. It is worth noting that most of the literature studying this sector is focused on the U.S. and Europe and provide useful insight albeit does not account for many of the Brazilian sector's particularities, which will be analyzed in chapter V.

The chapter is structured as follows: section section IV.1 reviews papers that deal with the basic conditions of supply and demand in the industry; section IV.2 exposes contributions to relevant market definition; section IV.3 explores barriers to entry in the sector; section IV.4 exposes common conducts of players in the industry; and finally, section IV.5 presents data envelopment analysis models as a solution to the problem of measuring efficiency in the industry.

IV.1 Basic Market Conditions

Notwithstanding, there are some characteristics of competition that help us define the basic conditions in the industry. Perhaps the defining aspect of competition dynamics in the industry is the **peer effects** characteristic underlying the sector, so that the product is a service that requires considerable effort from the buying part to fulfill its objective, and that the final quality depends on the "quality" of consumers. This directly impacts the incentives of HEIs to capture the most able students, since the greater the students' ability, the more successful the institution will be in its mission, and therefore it will attract better quality students, and so on. In other words, consumers are inputs in the production function of HEIs and the quality of the education provided depends on the "quality" of its buyers (McPherson and Winston, 1991; Rothschild and White, 1995).

This factor's relevance is even greater when one considers the existence of considerable **information asymmetry** regarding service quality (Salerno, 2004). In fact, when asked about the most important factors for competitiveness, most of the private institutions cited brand reputation and marketing,[18] which are directly related to the efforts to overcome the difficulties related to information asymmetry.

Such information asymmetry rises from the fact that higher education is an experience good – meaning that one must buy to fully assess its quality. In turn, the choice of purchase is rather costly since students usually take four years to graduate. This would be the only direct way to gauge a HEI's quality. On the other hand, much effort is made in the direction of providing indirect quality indicators, such as rankings – or even using an elevated price as a sign of elevated quality (McPherson and Winston, 1991).

There has recently been an important trend towards reducing costs in the sector worldwide, especially in the U.S. and U.K., specifically through distance learning and online courses as well as employment of non-tenure track teachers. This is consistent with a wider phenomenon in the economy, as there is a search for new industrial model with lower costs because of market pressures (Schejbal, 2012). However, it is not clear whether the public sector in Brazil has been particularly influenced by this.

On the other hand, it is easy to see how these basic conditions affect other variables of the paradigm. A school's effort to attract the better students can – with time – affect market structure (by increasing their prestige and obtaining a higher number of students), other school's conduct and even performance. That is because the pool of the highest quality students is finite, and that can be seen by the rankings of grades from admissions exams. With effect, schools that apply localized admissions exams are actively trying to 'steal' students from other local schools.

IV.2 Relevant markets

When defining relevant markets, one common point across the literature is that **geographic market boundaries have been widening**, with average distance traveled per student increasing and the share of local students in universities decreasing (Hoxby, 1997; Weisbrod *et al.,* 2008). On the other hand, product market definition can be a bit trickier,

---

[18] *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***

since most authors and antitrust authorities argue for a strict division based on courses, but others defend a division by area of knowledge.[19]

In accordance with the current antitrust practice, Becker and Round (2009) have built an useful checklist of five factors to consider when examining the matter of **market definition** in the higher education industry. The first item on the checklist is to start with the exact object of study (course, program, institution, and so forth) and the purpose of the inquiry.

Therefore, it is important to determine the exact scope of product market that one aims to assess, since:

> "it is easy to talk about the 'market for higher education', but this expression belies the many smaller, more specialized markets that exist. […] So two schools in the same state, or even in the same community, may be poor substitutes for each other, but each may be an excellent substitute for schools in distant locations. *A school that is perceived as unique in some material way is at least partially insulated from competition, which gives schools an incentive to seek out a market niche and advertise it."* (Weisbrod *et al.,* 2008, p. 46)

In order to achieve such definition, the second item in the checklist refers to the identification of substitutes, both in terms of demand and supply, to the institutions of interest. The goal here is to determine the group of institutions that face no competitive restraints from outsiders.

In terms of **supply substitution,** the current precedent set by antitrust authority for the undergraduate market is that product market consists of the individual courses offered by institutions. In terms of supply substitution, since teachers can be hardly employed outside their general area of expertise, it makes sense. Special attention must also be paid to applied courses that require expensive facilities and equipment, which constitute a necessity for the supplying of these courses and can hardly be used to other ends as well.

Additionally, in the absence of price, **quality** and prestige take a leading role when considering **demand substitution**. In fact, prospective students might not consider the

[19] For example, Teodorovicz and Leandro (2015) defend that closely related courses do present high substitution of supply and demand. Especially those in the same major knowledge field, such as engineering, health, biological sciences, economics, administration, and accounting etc.

same course in different institutions as substitutes. This happens not only with specific courses, but at the institutional level. In that regard, public and non-profit institutions tend to present higher levels of quality, for the simple fact that they are not maximizing profits, but rather their stated mission, usually related to quality and access (Massy, 2004; Weisbrod *et al.,* 2008).

And perhaps more important, even with a price difference, institutions need not be substitutable to every single student to widen the relevant market:

> "It has to be born in mind that not the average consumer's perspective is decisive, but that *a significant number of the marginal consumers considering a course or an institution as an alternative is sufficient to broaden a market*." (Gideon, 2017, p. 71, *emphasis added*).

This is where a separation between courses would be useful, as high-quality private institutions generally supply few courses, usually in the same general area of knowledge. Specifically, quality private institutions tend to be concentrated in business, economics, and law degrees. This separation will be further analyzed in the discussion regarding concentration, on section IV.2.2.

Considering that, we turn to the third item, which is the definition of **relevant geographic market**. For the case in hand, there are initially two scenarios. The first is the influence radius methodology, determined by Cade's jurisprudence. Designed to analyze private institutions, it has been defined as a 20km radius around which a certain institution might attract students. For convenience, this definition has been changed to a municipal influence radius.

Gideon's (2017) quote above supports the hypothesis that in the case of public institutions the space of competition might be larger. That is so because the influence radius method does not account for students that are choosing between schools. It considers only students already enrolled, which of course will be residing at least relatively close to the institution.

The literature has been continuously acknowledging that students are facing an increasingly wide market for higher education. In fact, Leppel (1993) concludes that distance is a key factor for students' decision only up to a certain distance. Of course, students closer to a certain institution show a greater probability of enrollment. However, after a certain distance (50 miles for her estimation), the probability of enrollment is significant and does not seem to diminish much as distance grows.

Data from the U.S. shows that the share of in-state students has been decreasing steadily in the time series used: from 93,2% in 1949 to 74,5% in 1994, reflecting a widening of geographic market. This decrease has been steeper for private colleges than public colleges, reflecting their quality differential. Private colleges have higher average quality in the U.S. and, therefore, have a greater geographic pull: from 80% in 1949 to 54,6% in 1994, while public colleges fell from 95,6% in 1949 to 84% in 1994 (Hoxby, 1997).

Another work that can give a starting point to defining a geographic market radius is McMillen *et al*. (2007), that estimated a regression between universities' tuition fees. The authors consider a 640km distance, or a day's drive, as a reasonable radius for substitutability between institutions. They also state that there are two groups of universities with a longer range of recruitment, one with national and the other with a regional grip on students, differing from a group of "comprehensive" universities, showing just local influence. Based on enrollment growth data, Weisbrod *et al.,* (2008) also argue that large four-year schools do not usually compete with local players, but with similar institutions at a greater distance.

Alm and Winters (2009) further add to this argument by concluding that inside state lines, the distance-elasticity[20] for students considering four-year degrees, especially in institutions with high-quality and research prestige, are much lower than for two-year colleges or institutions of lower prestige. This result is supported by Elzinga and Howell (2018) and Weisbrod *et al.* (2008) too, in the case of two-year versus four-year colleges, and it is no secret that, however different their products are, the quality of four-year colleges is perceived as higher than that of two-year colleges.

Potential competition comes in as the fourth item in the checklist, and it will be discussed in the sections referring to barriers to entry, both here in the empirical review and in chapter five. Fifth is the accounting of the **suppliers** to the institution, or the upstream players in the vertical chain. Unfortunately, suppliers and the vertical chain were not analyzed in this thesis due to the lack of data on the subject.

[20] Distance-elasticity refers to the measure of how the proximity of students to a certain school determines their propensity to enroll in said school.

IV.3 Barriers to Entry

Barriers to entry in the sector are closely related to regulation. First is the fact that public institutions charge much lower tuition than private institutions, hindering the latter's ability to competitively enter the market; and second is that the quality standards and requirements are so high that they command considerable investment and work to be met. These barriers are even more relevant when one considers the existence of considerable **information asymmetry** regarding service quality (Salerno, 2004). In fact, when asked about the most important factors for competitiveness, most of the private institutions cited brand reputation and marketing,[21] which are directly related to the efforts to overcome the difficulties related to information asymmetry.

IV.4 Conduct

The conducts that are most relevant for this sector are **discrimination** and **differentiation.** The "classical" form of discrimination is in price, which happens quite clearly in the U.S. higher education industry, for example. Nonetheless, when private universities provide scholarships based on merit or financial need, they are practicing price discrimination. It is arguable, of course, that this type of discrimination benefits consumers, as it charges a full price for whom can pay it, giving subsidies to those that cannot.

If there was no price discrimination, it would be extremely difficult to level the playing field between public and private universities. The lower price (or free tuition) of public institutions would make it impossible for private institutions to compete with public funded colleges (Salerno, 2004). In fact, a model aiming at correctly depicting a "market equilibrium" in the higher education industry must account for differentiation in price, especially between public and private institutions (Abwod, 1977). That way, it is desirable that institutions have different prices reflecting their intrinsic characteristics as well as serving different target audiences.

This amount of differentiation that is permissible refers to actions taken by players when they are attempting to attract more consumers by incrementing their product's quality. Players always have the incentive to differentiate oneself from one's competitors – especially in the higher education market, where quality is such an important variable

---

[21] *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***

(Weisbrod *et al.,* 2008). In fact, according to legislation, HEIs are free to create their *curricula* and, in turn, specialize in certain areas or courses, as well as differentiate their focus inside a given course.

Therefore, one concludes that the mixed oligopoly models and the two-good framework can be used as theoretical bases to understand competition in the higher education industry. This is an industry that possesses peculiar characteristics – namely information asymmetry and peer effects – that make it tricky to analyze. In terms of relevant markets, one must have in mind the exact object of study, the product market definition and the presence of substitutes to that object, what is the relevant geographic market, the existence of potential competition, and what are the suppliers to the institutions. In addition to that, barriers to entry play a major role in the industry. Finally, price discrimination and product differentiation are the main conducts carried out by players.

IV.5 Performance

This section focuses on exposing the methods and results of papers that have applied DEA to the higher education sector, focusing on how the results were interpreted and drawing the evidence in order to better apply the method and better interpret its results.

Focusing on the Brazilian higher education sector, Marinho, Resende, and Façanha (1997) calculate the relative efficiencies of 38 federal HEIs using data from the *Associação Nacional dos Dirigentes das Instituições Federais de Ensino Superior*[22] (ANDIFES) from 1994. They use 15 inputs and 9 outputs, including variables representing an institution's capital, as well as the usual teaching and research variables. Input variables used are area of buildings, area of hospitals, area of laboratories, total number of students, academic staff with doctoral degree, academic staff with master degree, academic staff with specialization degree, academic staff with undergraduate degree, academic staff of second and first degree teaching, administrative personnel at support level, administrative personnel with undergraduate degree or higher, budget for current expenses, incoming students at undergraduate level, and incoming medical residents. For output variables, they used number of undergraduate courses, number of graduate courses – master, number of graduate courses – doctoral, certificates issued –

[22] National Association of the Federal Higher Education Institutions' Managers.

undergraduate, certificates issued – medical school residence, number of master's degree thesis approved, number of doctoral dissertations approved, weighted average of MEC's evaluation – master's degree, weighted average of MEC's evaluation – doctoral degree. These variables are summarized in Figure 3:

Figure 3 - Marinho, Resende, and Façanha's (1997) Input and Output Variables (continues)

Variable Description	Type
Total area of buildings	Input
Total area of hospitals	Input
Total area of laboratories	Input
Total Number of Students	Input
Number of faculty members with doctoral degree	Input
Number of faculty members with master's degree	Input
Number of faculty members with specialization degree	Input

Figure 3 - Marinho, Resende, and Façanha's (1997) Input and Output Variables (ends)

Number of faculty members with undergraduate degree	Input
Number of faculty members with primary and secondary degree	Input
Number of administrative personnel at support level	Input
Number of administrative personnel with undergraduate degree or higher	Input
Total budget for current expenses in R$	Input
Number of incoming students at undergraduate level	Input
Number of incoming medical residents	Input
Number of undergraduate courses	Output
Number of graduate courses - master	Output
Number of graduate courses - doctoral	Output
Number of certificates issued - undergraduate	Output
Number of certificates issued - medical school residence	Output
Number of master's degree thesis approved	Output
Number of doctoral dissertations approved	Output
Weighted average of MEC's evaluation - master's degree	Output
Weighted average of MEC's evaluation - doctoral degree	Output

Source: elaboration by the author based on Marinho, Resende, and Façanha (1997).

Then, the authors apply factor analysis on input and output variables, then applying the BCC model of DEA. Their results show that 42% (16) of the DMUs have the maximum score of 1, with low standard deviation, and the lowest value being that of the UFAC, at 0,77, showing great overall relative efficiency for the federal universities in Brazil.

Using a sample of 45 HEIs from the UK, Athanassopoulos and Shale (1997) run two specifications of the DEA model, one with constant returns to scale (CCR) and one with variable returns to scale (BCC). They also separate inputs into two sets, the first translating cost efficiency and containing general academic expenditure and research

income as inputs, as well as number of successful leavers, number of higher degrees awarded, and weighted research rating as outputs. The second set concerns outcome efficiency, with the inputs of number of full-time equivalent (FTE) undergraduates, number of FTE postgraduates, number of FTE academic staff, mean A-level entry score over the last three years, research income, expenditure on library and computing services. For outputs, they used the same as the first set (Athanassopoulos and Shale, 1997).

Their results showed that the efficiency under CRS and VRS specifications varied 7%, with CRS being always less efficient. Specifically, the lowest measure was of 36,73%, in the model with all universities under CRS. They were also capable of identifying that the less efficient universities (< 94% efficiency) should reduce staff.

In another study using a sample of English HEIs, Johnes (2006) stresses that it is important to apply DEA separately between peer groups of DMUs, if it is suspected to exist differences in efficiency between these groups. After applying Pastor *et al.*'s (2002)[23] test in a set of candidate variables, he chooses as inputs the number of FTE undergraduate students weighted by quality, total number of postgraduate students, total depreciation and interest payable in British pound (£), and expenditure on administration services. As outputs, a measure of degrees awarded weighted by quality, the number of postgraduate degrees awarded, and the value of the research grant awarded by the government are used.

He finds a very high average efficiency, ranging from 93 to 95% depending on input variable choices. This high efficiency average in a not-for profit sector can be explained firstly by the fact that DEA measures only relative efficiency. However, he argues that the English higher education sector has been exposed to market reforms and market forces since the 1990s, which has most likely improved the sector's efficiency. Interestingly, the author calculates scale efficiency as the ratio of the CRS model efficiencies to the VRS model efficiencies, obtaining a 96% score for scale efficiencies. It is also stated that DEA efficiency results can be seen by inefficient DMUs as a guideline, by observing what the fully efficient DMUs are doing differently and implementing such practices (Johnes, 2006).

[23] Pastor *et al*. (2002) propose two tests for choosing variables in DEA models. See the full article for more information.

Coming back to Brazil, Cavalcante and Andriola (2012) apply the BCC model using 30 courses of the Federal University of Ceará (UFCE) as DMUs, for years 2006 to 2009. The inputs used are incoming students and a composite index reflecting faculty effort, assigning greater weight to the hours of teachers with doctorate and master's degrees. In terms of outputs, they use the number of graduating students, number of students with a teaching scholarship, number of students with research scholarships, number of research projects, number of students in extension activities, and number of teachers in extension activities. His results show that nine of the 30 courses obtained the maximum efficiency score through the period analyzed, while five courses had efficiency lower than 80% throughout the years. However, most of the courses showed great variability through the years.

Costa *et al.* (2015), on the other hand, apply a dynamic DEA model and Malmquist Index[24] on a data set of 49 federal HEIs from 2004 to 2008. They also separate HEIs into two peer groups, according to teaching, research, and extension activities and characteristics. For inputs and outputs, the authors preferred to use weights whenever possible. As inputs they used costs/student, students/teachers, students/technical staff, and a qualification index of faculty. Outputs used were graduated students/enrolled students, and Capes' grade. Their results showed that withing group A, composed of 28 HEIs focused on research, 64% of universities were efficient throughout the period, with 22% being inefficient, and 14% being efficient at some point. For group B, made of 21 universities focused on teaching, 76% were fully efficient throughout the period. However, Malmquist index showed that there was a loss of productivity for the majority of DMUs in the period analyzed, perhaps explained by the gap between an expansion of inputs in the period analyzed and the delayed response in corresponding output variables.

Teixeira *et al.* (2018) also assessed the efficiency of 44 federal HEIs using DEA and the Malmquist Index. Current costs, FTE teachers, FTE technical staff, and a faculty qualification index were used as inputs, while the Capes grade, rate of graduates and the *Índice Geral de Cursos*[25] (IGC) were used as outputs. However, their results paint a very different picture, with only 25% of DMUs being efficient in 2007, and 32% in 2011. The

[24] To assess productivity and technical efficiency changes over time. See Malmquist (1953) and Tone (2004).
[25] A composite index of quality indicators provided by the Ministry of Education.

Malmquist Index showed only a 0,2% change in technical efficiency for the period analyzed.

On the other hand, Marques, Camara, and Carvalho (2019) first apply a multiple regression technique on variables for control purposes, regressing the grades of students on the specific portion (subjects related to the student's course) of Enade (national exam of student performance) against their socioeconomic background and the grade on the general knowledge portion of Enade. Then, they calculate efficiencies for business administration courses only, from 40 HEIs, via DEA (VRS) for two components: student performance and HEI efficiency. Findings suggest that courses from public institutions are, in average, more efficient than private.

Finally, Peyerl, Ferrari, and Domingues (2019) analyze the 20 best placed accounting courses in the country for the year 2016, being 10 from public institutions and 10 from private institutions. Inputs used were the number of teachers, number of technical staff, expenditure with salaries of teachers and technical staff, expenditure with maintenance and investments. For the outputs, the CPC (preliminary course grade), Enade, and the IDD (indicator of performance difference) were used. Applying a VRS model, the authors find that only two HEIs are not efficient: UFF and PUC-Minas.

Except for the applications of DEA above, the majority of the empirical literature treated above deals with U.S. or European higher education, and the existence of price discrimination by public institutions, among other characteristics, differs greatly from what happens in the Brazilian industry. Nonetheless, all these insights are very useful towards the understanding of the sector's competitive dynamics and add considerably to this analysis. Now we turn to the competitive analysis of the public higher education industry in Brazil.

V The Public Higher Education Industry in Brazil

In this chapter, the theoretical concepts exposed earlier will be the tools to assess the nature of competition in the public higher education industry in Brazil. While public players will be the focus of this chapter, private players can be deemed as competitors. Parallels will be traced between the public and private sector when deemed useful, since there is a richer body of literature to draw on that concerns the private sector. Additionally, however different they may be, it is clear that these sectors exert at least some competitive pressure on one another in certain occasions, and that will be explored when it is considered most relevant to the public sector's dynamic.

As has been said before, it might seem counterintuitive to talk about competition between public institutions, especially since they do not charge any tuition. Nevertheless, public HEIs are competing fiercely for students. Not only amongst themselves but with private institutions as well. Public HEIs might also compete for research grants and other productivity related benefits. Here the focus is exactly on identifying how these institutions compete in a setting where the product price is zero. The aim of this chapter is on identifying and analyzing competition focused on the public higher education sector, with special attention to geographic market determination and to conducts carried out by the players.

The chapter is structured as follows: the first section provides a description of the higher education product, presenting the basic conditions of supply and demand, according to the SCP paradigm, as well as an overview of the data used in this thesis, in order to contextualize the developments that will follow; section two consists on the definition of relevant markets and the analysis of market structure elements of the industry; section three analyzes barriers to entry in the industry; the fourth section analyzes institution's conducts as their main courses of action in a sector characterized by competition without a price system; finally, section five puts forward an analysis of performance variables for the sector, attempting to combine these data with the other variables presented with the aim of providing a competitive framework of the sector.

V.1 An Introduction to the Higher Education Product and Industry in Brazil

V.1.1 Basic Conditions of Supply and Demand

In terms of the **basic conditions of supply** in the sector, perhaps the most important characteristic of this industry is that it is highly regulated and heavily defined by legislation. Specifically, Law 9394/96 sets the directives and baselines of national education. Article 43 provides the mission statement of higher education in Brazil, which emphasizes cultural and academic diversity, research, and integration with local communities. Additionally, the legislation determines that education in public schools will be completely free of tuition at all levels of education. Another important directive is the guarantee of a quality standard, enforced by the Ministry of Education (MEC) through a grading system, and the guarantee of access to higher levels of education and research according to individual's capacities (Brazil, 1996).

Notedly, regulation in the sector has a huge impact on barriers to entry. However autonomous public HEIs may be in academic terms, new public HEIs must be created by law, which is a complex and bureaucratic process. This is even more relevant if considered that public HEIs do not usually compete directly with their private counterparts – although there are exceptions – because of the difference in quality. That might result in diminished competition in geographic terms, which will be further explored. There is also intense course accreditation and regulation, which contributes to barriers to entry (Brazil, 1996).

The National Education Plan (*Plano Nacional de Educação, PNE*) is the piece of legislation that sets the goals and strategies for the education sector. The effect of the law on the conduct of players, especially public institutions, must not be undermined. For example, it sets the goal of increasing enrolments and the shares of these new enrolments in the public sector (Brazil, 2014). Interestingly, that could constitute another source of rigidity in public sector conduct, since it makes public institutions less flexible to market demands (Teodorovicz and Leandro, 2015). However, political tension and instability have hindered the achievement of these goals – particularly regarding the public sector's role in this new expansion, as shown by the constant reduction in the share of public enrollments over the years.

In fact, the access to higher education in Brazil has increased greatly since the 1960s, especially since the 2000s. However, at a first glance, public universities have

been losing ground. The share of private institutions has been increasing steadily (INEP, 2018; SEMESP, 2018). Not only that, but the private sector is becoming increasingly concentrated in the hands of a few players, mainly through a merger wave that cooled down in 2016, when the merger between two of the biggest players in the market – Estácio and Kroton – fell through. Nevertheless, the private sector keeps increasing its share of total students over the public sector (INEP, 2018).

Closing out the conditions of supply, the main inputs to the HE education product are human capital, in the form of teachers, as well as facilities and infrastructure, in terms of physical space for classes, laboratories, equipment and such. Scale economies are present in the sector, pointing to a slight tendency to concentration in the market.[26] While there are new models of distance and online education thriving, the public sector sticks to presential activities for the majority of its curriculum, and dedicated distance courses are quite rare.

In terms of **basic demand conditions**, since tuition is free, it is very tricky to calculate the elasticity-price of demand.[27] The matter of substitutability will be discussed with relevant market definition – although in the absence of price one can assume that quality will take a more prominent role for substitutability.

The most important factor here is that the demand for higher education in Brazil has been growing exponentially for the last decades: since 1996 the number of enrollments has grown approximately 550%. While most of that demand has been absorbed by lower quality private institutions, the public sector has also expanded its operations and its capillarity. "Lower quality" refers to the fact that these private institutions do not place much importance on research activities, as their aim is to provide practical, market-oriented education to students hoping to enter the labor market. Supporting the quality differential argument is the fact that public institutions have a greater share of teachers with graduate degrees and experience in research activities.

Now, we turn to scrutinize the actual data regarding Brazilian HEIs.

---

[26] This sentence is based on Cade's *Superintendência-Geral's* judgment on the case of the acquisition of Estácio by Kroton, in 2016: "*Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***" This document will be referenced in the footnotes, since there is no predetermined way to reference it.

[27] For methods to calculate demand elasticity in higher education markets, see Campbell and Siegel (1967) and Avery and Hoxby (2004).

V.1.2 An Overview of the Data

The database utilized to calculate most indexes here is the Higher Education Census (*Censo de Educação Superior, CENSUP*), available as microdata on the *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*[28] (INEP) website.[29] All data exposed in this thesis, otherwise specified, concerns the year of 2018. Data are available in five main files, concerning students, courses, professors, institutions, and the location in which courses are offered. Each line of each file represents one observation of the variable of interest. For example, in the file regarding students, each line represents one student, while each column specifies a variable – a particular information regarding the student – i.e., what institution are they enrolled in, whether it is a public or private institution, whether the student gets funding or not, and other useful information.

A college is the first classification a HEI receives. Colleges are usually centered around one area of knowledge and have no organizational autonomy in the sense that the courses and activities offered must be approved by the Ministry of Education (MEC). University centers, on the other hand, are given organizational autonomy but are not required to produce research or offer extension activities, which is the prerequisite of universities. In addition to that, in order to be granted the status of university, a HEI must have one third of its faculty with a master's or a PhD degree, as well as on a full-time regime. Table 1 brings general information regarding the distribution of students between HEIs in Brazil:

Table 1 - General Statistics All Students (continues)

HEI Category		
Type	**Students**	**Share**
Federal	1.673.218	13,9%
State	822.823	6,8%
Municipal	87.798	0,7%
Private For-Profit	6.458.477	53,6%
Private Non-Profit	2.968.933	24,7%
Special	32.744	0,3%
HEI Ownership		
Public	2.583.839	21,5%
Private	9.427.410	78,5%

[28] Anísio Teixeira National Institute of Educational Studies and Research.
[29] https://www.gov.br/inep/pt-br/areas-de-atuacao/pesquisas-estatisticas-e-indicadores/censo-da-educacao-superior/resultados

Table 1 - General Statistics All Students (ends)

Academic Organization		
University	6.351.280	52,7%
University Center	2.770.486	23,0%
College	2.666.230	22,1%
Federal Institute of Technology	238.675	2,0%
Federal Center of Technical Learning	17.322	0,1%
Academic Degree		
Bachelor's	7.885.658	65,8%
Licentiate	2.315.715	19,3%
Technical	1.777.149	14,8%

Source: elaboration by the author based on data by INEP (2018).

We can see that while Federal and State institutions dominate the public sphere, private institutions take more than three quarters of students – precisely 78,5%. This is consistent with the recent trend of massification in higher education through somewhat lower quality private institutions, especially when taken into account the fact that 53,6% of all students in the industry study in private for-profit schools. Accordingly, less than half of students is enrolled in public or private non-profit schools.

Nevertheless, private institutions have been steadily gaining ground on public institutions. Public institutions held 19,75% of the industry while private institutions held 81,25%[30] in 2018 (INEP, 2018), versus 39,36% and 60,64% in 1996 (INEP, 1996), the year that Law 9394 was passed.

Regarding the academic organization of institutions, more than half of students (52,7%) is concentrated in universities, while university centers and colleges take approximately 22% each, and technical institutes concentrate only 2% of the students. Finally, most students are enrolled in courses that provide a bachelor's degree – exactly 65,8% - with 19,3% in licentiate courses and 14,8% in technical courses. Table 2 brings data regarding student admissions and funding:

Table 2 - Students Admissions and Funding All Institutions (continues)

Admissions		
Type	**Students**	**Share (%)**
ENEM	2.555.573	21,2%
Independent	8.084.377	67,1%
Others	1.404.043	11,7%

[30]Considering universities, university centers and colleges, the three types of institutions that provide undergraduate courses.

Table 2: **Students Admissions and Funding All Institutions (ends)**

Student Funding and Aid		
Funding (General)	3.764.569	39,9%
FIES Refund	934.106	9,9%
HEI Non-Refund	3.543.446	37,6%
PROUNI Full	480.706	5,1%
PROUNI Partial	171.482	1,8%
State Refund	3.754.973	39,8%
State Non-Refund	3.719.118	39,5%
Municipal Refund	3.756.174	39,8%

Source: elaboration by the author based on data by INEP (2018).[31]

In terms of the admissions processes, independent exams are by far the preferred method by HEIs, as 67,1% of students enroll through it. ENEM (*Exame Nacional do Ensino Médio*) a country-wide test accepted by all public and some private institutions, cares for 21,2% of enrollments, while other methods come to 11,7%. The large share of students enrolling by independent exams can be interpreted as an attempt by HEIs of exerting geographic dominance, as will be explored further ahead. Concerning financial aid, 39,9% of students in private institutions get loan funding or aid. Financial aid and funding are also another way that HEIs can attract better students to themselves.

Notwithstanding, to get a true competitive snapshot of the sector, the picture of which institutions effectively compete amongst themselves must be painted. Now, we turn to the definition of relevant markets and the calculation of each of these markets' concentration ratios.

V.2 Structure

V.2.1 Relevant Markets

And to do that, the first required step is the **relevant market definition**. First, product market definition will be carried out, followed by geographic market definition. For the specific case of Brazil, the classic SSNIP hypothetical monopolist test (small but significant and non-transitory increase in price) is not a good option, since tuition is free for public institutions. That does not mean it is not useful either. One can use a part of its

[31] Funding data is a bit confusing. It seems that students can get more than one type of funding. Even so, it is a bit tricky to separate these types. Nonetheless, the more important here is to see the share of students that receive funding directly from their HEI.

algorithm, even without calculations. Specifically, one can start with small markets and test them against hypothetical consumer choice, widening the markets as seems fit.

In accordance to Becker and Round's (2009) checklist for defining relevant markets in the higher education industry, we start with the object of study. As said before, the central object of study here is the high-quality public higher education sector. Initially, with no distinction between courses.

Thus, the first checkpoint to defining **product relevant market** is that there are three categories of HEIs in Brazil: colleges, university centers and universities (*faculdades, centros universitários e universidades*). Students (consumers) choose between HEIs according to several criteria: tuition price, school quality, the student's grade on admissions, distance to the student's hometown etc. Turning to item number two on the checklist, addressing **supply substitution**, although these types of institutions might differ in terms of managerial autonomy, they mostly provide *undergraduate degrees*, which is the focal point of this analysis. Remembering the objectives of this thesis, the analysis is centered around institutions that grant undergraduate degrees to students. Specifically, degrees granted in the *presential modality*, in contrast to distance education.

Here, the argument that the current jurisprudence can be considered narrow will be constructed based on the literature presented before. It is narrow for two reasons. Once again, the focus of this thesis is to find broad patterns of competition in the sector. It is safe to assume that the dynamics of competition – in other words, the interaction between institutions – does not vary greatly between specific courses (product markets). Therefore, it escapes the scope of this analysis to assess every single horizontal product market separately. This is not an attempt to identify market power, but rather an explorative analysis. Second, when dealing with public institutions the number of courses that do not overlap is usually small. Public institutions offer a diverse set of courses, and the occasional one that differs from what other institutions are offering is usually attributed to a specific specialization of that institution. Nonetheless, the majority of the public institutions studied here offer the same courses – courses with high demand, fiercely disputed by prospective students. Therefore, when devising the general framework of the industry, it can be useful to look at the sector with no in-depth product

market (in terms of the separation between specific courses) division – however, using quality as a primary product market definition criteria.[32]

The competition that public institutions face from private HEIs is from a higher quality, usually research-focused institution. In other words, while there are private institutions competing with high-quality public institutions, they are not the same schools that have had relevant markets defined by antitrust authorities.[33] With effect, the argument here is that there is indeed competition for students between quality public institutions and private non-profit institutions, especially since the private schools at hand are able to provide either funding or student aid based on merit or socioeconomic need.

When making the choice between public universities, students might be seeking to enroll in the institution of the highest quality – in accordance with their grades in the selection exams. And since tuition is free, a great share of the students would be willing to move to other cities, depending on the distance to their base location, their socioeconomic background, and the quality of the institution.

The fact is that, while private institutions have greater geographic capillarity with a greater number of facilities in a greater number of cities, public institutions tend to be more geographically localized and have a wider range of recruitment (Teodorovicz and Leandro, 2015). That makes sense, as the market for private institutions is, indeed, usually municipal. On the other hand, markets would be wider when considering public institutions because these institutions tend to be regional poles and attract students from their surrounding cities. When accounting for top tier institutions, it could even be considered a national market. This argument holds for top tier private institutions as well, which could offer full or partial scholarships to "capture" top students from other states and even regions, supporting a national market scope.

Additionally, remembering Alm and Winters' (2009) argument that high quality institutions have a greater pull on students from other states, we argue that a third possible

---

[32] Precedents on antitrust decisions in Brazil have defined only a branch of the higher education market, limited to the private mass education institutions, with lower quality in general. In that case, the geographic scope of a municipal market is fitting, since a great part of the students looking to study in these institutions are usually employed and looking to specialize – hence their lack of incentive to move to another city
.

[33] *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***

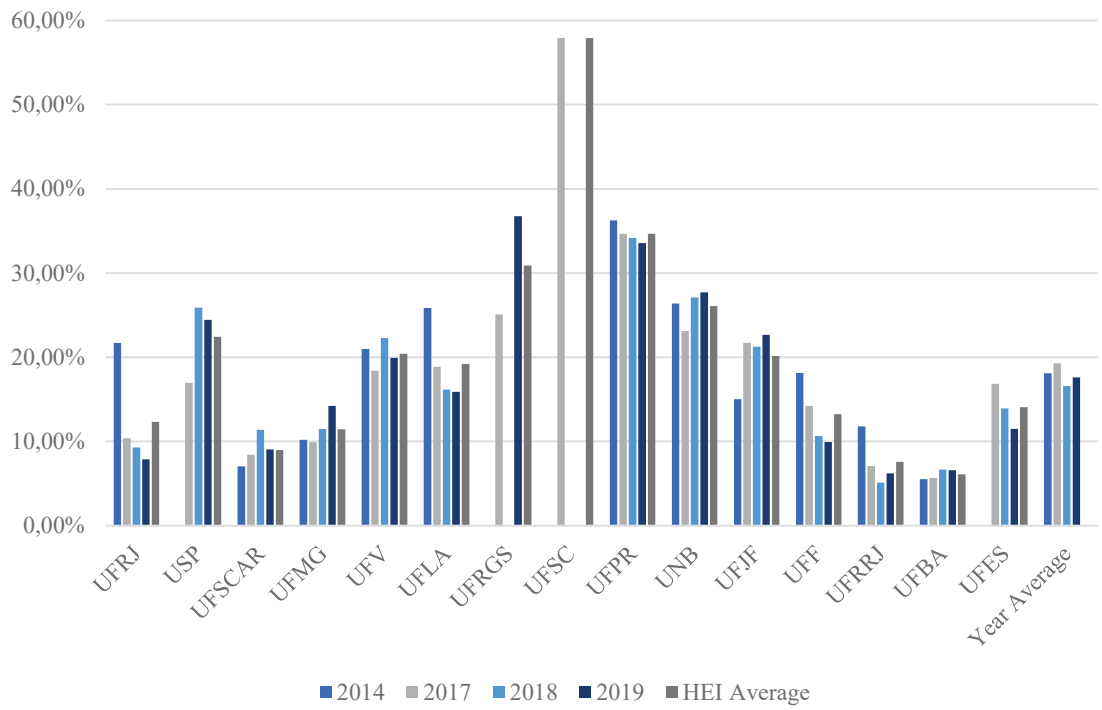
scope of geographic market is one according to the country's regions – here the Southeastern region will be analyzed.

This definition is aimed at assessing competition at the regional level, accounting only for institutions with high quality, but not only the top schools. An interesting exercise to be made here is to look only to public institutions in the region. One can justify this exercise because not all private institutions can provide scholarships to all students in need. While this restriction has been relaxed on the national scope, because students would be fighting to enroll in the absolute top institutions in the country, and institutions would be fighting for the best students in the country, this definition attempts to account for this restriction. Therefore, it accounts for institutions with high quality, but that do not have such a strong grasp on the national market and separates a market with both types of institutions and a market comprised only of public institutions.

In fact, data from RAMEC (*Repositório de Arquivos do MEC*) showing student enrollment for public institutions support the argument of a wider geographic scope of competition for public institutions. The time series is not very long nor sequential – there is only data available for 2014 and 2017-2019.[34] Nevertheless, we can compare these results with Hoxby's (1997) and confirm that students from different states are a considerable portion of top public institutions' enrollment. Figure 4 shows the share of out-of-state students enrolling in a certain HEI for the years available in the data series:

[34] Also, some years are missing for some HEIs.

Figure 4 - Percentage of Out-of-State Students Per Institution Per Year



Source: elaboration by the author based on data by RAMEC (2018).

With yearly averages around the 18%-mark (close to the 25,5% for all institutions in Hoxby, 1997)[35], one can conclude that out-of-state students play an important role for HEIs' admissions policy. Unfortunately, it is impossible to get a longer time span and ask whether this number has been increasing or decreasing through the years. It would be particularly interesting to gauge this data considering the period before and after the implementation of ENEM (National High School Exam) and SISU (Unified Selection System) in 2010, which might have been a force of change in this regard. However, the first available year for this data is 2014.

The share of out-of-state students differs between institutions. Of course, this might be due not only to the institution's quality and its ability to capture the best students from out of state, but on the very characteristics of its location – for example, how close to the border it is and how large or dense its state is. All in all, it is a combination of a HEI's quality and 'geographic pull' and its location in relation to other states. Accordingly, the shares range from 5,52% for UFBA in 2014, to 57,92% for UFSC in

[35] Although it is hard to compare these figures because of the different environment, Hoxby's (1997) results can be used as a starting point.

2017, showing how specific traits of each HEI can influence this number, as UFBA is an institution with an IGC of four, and is located rather centrally and away from the borders in its state, which is a rather large one. On the other hand, UFSC is a HEI with a rating of five on its IGC and is located very close to state borders.

Additionally, one must consider that many institutions, UFSC included, carry out independent admissions programs, which are regionally located. Therefore, in these cases the figure of students enrolled via ENEM are inflated. This topic will be further discussed in section V.3.2, when assessing conduct, since this can be considered an attempt to exert geographic dominance.

This discussion is interesting because it supports the structure of a wide market for higher education in Brazil. Thus, there would be, at first glance, little room for market power abuse, since a particular player will be facing competitive pressure from many competitors – and since tuition is free for public players, this would put pressure to keep high-quality standards.

Regarding potential competition (although barriers to entry will be more closely examined further ahead), given that barriers to entry are strong in the industry due to legal and regulatory requirements, it is safe to advance the conclusion that potential competition generally does not constrain potential market power in the sector. Therefore, the group of institutions taken as relevant market does not suffer pressure from potential entrants.

Thus, I propose three scopes of relevant geographic markets for the sector, accounting only for high-quality HEIs. The first is a municipal market, drawing from Cade's jurisprudence. Examples to be analyzed here are São Paulo, Rio de Janeiro, and Belo Horizonte. This scope constitutes perhaps the less intense competition dynamics, because of the limited geographic scope, since there are just a few players. The second is a regional market, composed of high-quality institutions. Here two markets are devised, one accounting for public and private HEIs, and another with only public institutions, since it is hard to determine whether all private schools can compete at this level. The last and wider definition would be a national market comprised of the institutions with the highest prestige and quality, accounting for the best institutions in the country, led by public universities but also containing a few private institutions. Therefore, the analysis starts with the wider geographic definition possible and gets more localized. Then,

product relevant markets will be assessed for business administration, economics, and law degrees.

V.2.2 Concentration

Data used to calculate market share and other structure variables are taken from the CENSUP and refer only to the year of 2018. The choice to only analyze the year of 2018 is justified by this thesis' time constraint and the sheer amount of data necessary to assess each year within the objectives of this thesis. Here, the IGC, or General Course Index, is used as quality benchmark and **primary product market definition criteria**. It is a composite index of quality made available by the Ministry of Education. It is composed of the *Conceito Preliminar de Curso*[36] (CPC), the Capes graduate course rating[37], and the share of students enrolled in graduate courses for the institution. It is worth stressing that the goal here is that of comparison between different scopes of regional and product markets – that is why there are so many relevant markets analyzed here.

V.2.2.1 Municipal Markets

Starting with the municipal scope, it is useful to begin with a hypothetical exercise. The first market analyzed is composed of the institutions with the highest quality rating (IGC = 5) in the city of Rio de Janeiro. This relevant market would be composed of only four institutions: the Federal University of Rio de Janeiro (UFRJ), the Getúlio Vargas Foundation (FGV), the Military Institute of Engineering (IME), and the Souza Marques Foundation (EEFTESM). This definition is based on the facts discussed on the relevant market definition section: prestigious private institutions do compete with prestigious public institutions. The quality limitation is a consequence of students' demand and their perception: they aim to enroll in the best institutions possible.

In this scenario, UFRJ is effectively a monopolist. It holds almost every student in the market, with a 97,78% market share. Its closest competitor would be FGV, with only 1,98% market share. The two other players in that compose this relevant market are

[36] Ranges from one to five and is in turn composed by the Exame Nacional de Desempenho dos Estudantes (Enade, or National Exam of Student Performance) which measures undergraduate students' knowledge, the *Indicador de de Diferença entre os Desempenhos Observado e Esperado* (IDD, Indicator of Difference between Expected and Observed Performance), the percentage of PhDs and masters in the faculty, and finally by the students' perception about their courses.
[37] Measures the quality of graduate programs, ranging from one to seven.

representative of a conduct variable that will be discussed later: product differentiation. EEFTESM is a specialized private school providing only nursing courses. IME, on the other hand, is a public institution focused on engineering courses. Both present a very low number of students but provide high quality for the courses they offer. Of course, the CR_4 is equal to 100%, which would constitute a *de facto* oligopoly. Additionally, the HHI is very close to its maximum value of 10.000 points. This greatly exceeds the "very concentrated" benchmark of 2.500 points set by antitrust authorities.

This is also a good example of how top-quality public institutions concentrate students. With almost 98% of the market, the public sphere dominates this scope of market definition. Students willing to enroll in a top-quality school in the city of Rio de Janeiro would have little choice, not only between institutions, but also of different courses among institutions. This is the perfect example of a narrow market definition. If one accounts only for the best quality institutions at the municipal level, concentration indexes will not constitute good competition proxies. That is so because this type of institution competes at a much wider geographic market.

Additionally, another reservation to be made regarding this scenario is that, in this scope, the correct product market definition would be to analyze course by course, since EEFTESM provides only one course, FGV supplies five and IME supplies 10, versus 84 from UFRJ. Product markets could be divided into three groups, according to these institutions: nursing is the first, administration, economics, law, social sciences, and mathematics is the second, and the third is made of the ten courses in the area of engineering offered by IME.[38] An analysis of different product markets will be made at the end of this section.

V.2.2.1.1 Rio de Janeiro

Just by adding schools with an IGC of four, the market takes a less concentrated shape, as shown by Table 4:

Table 4 - Market 1: City of Rio de Janeiro IGC = 5 & 4

Institution	*Ownership*	*Students*	*Market Share*
UFRJ	Public	48.185	24,47%
UFF	Public	35.598	18,08%

[38] These courses are: civil engineering, chemical engineering, electric engineering, engineering of materials, mechanical engineering (involving weaponry and vehicle engineering), electronic engineering, and communications engineering.

Table 4 - Market 1: City of Rio de Janeiro IGC = 5 & 4

Institution	*Ownership*	*Students*	*Market Share*
UERJ	Public	28.730	14,59%
UNICARIOCA	Private	19.044	9,67%
PUC-RIO	Private	16.444	8,35%
UFRRJ	Public	13.130	6,67%
UNIRIO	Public	12.204	6,20%
CEFET/RJ	Public	7.879	4,00%
IFRJ	Public	4.481	2,28%
FSJ	Private	3.824	1,94%
MACKENZIE RJ	Private	2.464	1,25%
ESPM	Private	1.895	0,96%
UEZO	Public	1.065	0,54%
FGV Rio	Private	982	0,50%
FSB/RJ	Private	307	0,16%
IME	Public	297	0,15%
ESNS	Private	218	0,11%
EEFTESM	Private	119	0,06%
FACESGRANRIO	Private	37	0,02%
Total		196.903	100,00%
Private Sector		45.334	23,02%
Public Sector		151.569	76,98%
CR4			66,81%
CR8			88,03%
HHI			1412,82

Source: elaboration by the author based on data by INEP (2018).

UFRJ is still the biggest player in the market, with approximately 24,5% market share. However, there are new considerably big players, both public and private. UFF comes second with 18% and, while located in the neighbor city of Niterói, most of its *campi* are just a 20-minute ferry ride away from downtown Rio, under the 20km range. Being a high-quality, large, and diverse institution, it must be accounted for. Unicarioca and PUC-Rio appear as the two biggest private players, and as the only private players with a market share higher than 2%.

Nonetheless, this market could still be considered mildly concentrated, with a CR_4 of 66,81% and CR_8 of 88%, despite the HHI being almost 100 points below the initial threshold of 1.500 points. There are a few big players and many smaller ones, with larger players being mostly public HEIs, with the exception of Unicarioca and PUC-Rio. This points to a tendency of symmetry between certain players, namely these two groups: one composed of big public institutions, and the other composed of small private institutions.

V.2.2.1.2 Belo Horizonte

Moving to Belo Horizonte, Table 5 puts forward the picture of a much more concentrated market than that of Rio de Janeiro:

Table 5 - Market 2: City of Belo Horizonte IGC = 5 & 4

Institution	*Ownership*	*Students*	*Market Share*
PUC MINAS	Private	35.736	45,08%
UFMG	Public	35.080	44,25%
CEFET/MG	Public	3.909	4,93%
ESDHC	Private	3.309	4,17%
FAJANSSEN	Private	464	0,59%
ISTA	Private	282	0,36%
EG	Public	268	0,34%
FAJE	Private	228	0,29%
Total		79.276	100,00%
Private Sector		40.019	50,48%
Public Sector		39.257	49,52%
CR4			98,43%
CR8			100%
HHI			4032,53

Source: elaboration by the author based on data by INEP (2018).

Here, despite the greater equilibrium between the public and private sectors, there are only eight players in the market. Not only that, but the four biggest players hold 98,5% of the market. Additionally, the HHI is considerably higher than the 2.500 points, at 4.032 points, which translates into a very concentrated market. This could be considered an effective oligopoly.

The largest player– by a small margin – is PUC Minas (45,08%), a private school. It is followed closely by UFMG (44,25%), the main public school in the state. Together, only these two players hold a combined market share of 89,33%, which is very high. The third biggest player is CEFET/MG, with 4,93% of the market, followed by ESDHC, with 4,17%. Three schools with a share lower than 1% complete the market.

Overall, 60% of students in private schools receive some form of special funding or scholarship. PUC-Minas and ESDHC offer aid to more than half of their students – specifically, to 61,4% and 60,6%, respectively. FAJE also provides students with considerable aid, at 27%. Therefore, it is arguable that these private institutions can indeed rival public high-quality institutions.

V.2.2.1.3 São Paulo

Turning to the city of São Paulo, Table 6 brings the scenario of a market with many players:

Table 6 - Market 3: City of São Paulo IGC = 5 & 4 (continues)

Institution	*Ownership*	*Students*	*Market Share*
UNINOVE	Private	153.407	56,01%
USP	Public	40.344	14,73%
MACKENZIE	Private	31.102	11,36%
PUCSP	Private	15.218	5,56%
UNIFESP	Public	8.327	3,04%
ESPM	Private	5.073	1,85%
FECAP	Private	3.754	1,37%
IFSP	Public	3.235	1,18%
FGV SP	Private	3.149	1,15%
INSPER	Private	2.699	0,99%
FAPCOM	Private	1.372	0,50%
FCMSCSP	Private	1.079	0,39%
SINGULARIDADES/ISESP	Private	795	0,29%
UNESP	Public	705	0,26%
FCE	Private	713	0,26%
FICSAE	Private	602	0,22%
ESP	Private	439	0,16%
FSB	Private	354	0,13%
ESNS-SP	Private	270	0,10%
FTBSP	Private	252	0,09%
FIPECAFI	Private	245	0,09%
FCI	Private	186	0,07%
FACEPD	Private	151	0,06%
ITESP	Private	177	0,06%
FFIA	Private	143	0,05%
ISE VERA CRUZ	Private	47	0,02%
FATIPI	Private	60	0,02%
Total		273.898	100,00%
Private Sector		221.287	80,79%
Public Sector		52.611	19,21%
CR4			87,65%
CR8			95,09%
HHI			3532,76

Source: elaboration by the author based on data by INEP (2018).

Yet, it is a highly concentrated market. With a CR_4 of 87,65% and a CR_8 of 95,09%, this relevant market stands in between Rio de Janeiro (as the less concentrated) and Belo Horizonte (with a CR_8 of 100%). The biggest player in the market is by far

UNINOVE, with 153.407 students and 56% of the market. This is the biggest player for all markets in the year of 2018, and it is a private school. USP comes as a distant second, with 14,73%, followed by Mackenzie, with 11,36%. The private sector holds almost 81% of the market in the city of São Paulo, that being by far the highest share amongst the capital cities studied here. Additionally, approximately 34% of students in private school receive funding aid or scholarship.

It is worth noting that USP is considered by many universities rankings as the best institution in the country. Being prestigious and highly selective, it is not the biggest public university in the country. In fact, while public institutions do not hold a great share of the city of São Paulo, the scenario changes when assessing a wider definition.

V.2.2.2 Regional Markets

The second scenario aims to calculate market shares and concentration indexes at the regional level, considering the Southeastern region of the country. This region is quite representative of quality HEIs, being the region with the highest number of such institutions, as well as the region with the most students. Table 7[39] provides the market shares and concentration indexes for institutions in the Southeastern region, with an IGC rating of four or higher.

The composition of this relevant market in terms of number of institutions and number of students provides interesting insight. Here, the number of enrollments is quite balanced between public and private institutions. However, when accounting for the number of institutions according to ownership, the share of private institutions is of 73,8% and of public institutions is of 26,2%. Consequently, the average size of public institutions, at 14.670 students, is indeed higher than that of private institutions, at 5.052. That might be because public institutions tend to provide more courses, in average. As discussed, this reflects the private sector's tendency to provide courses that are more cost-effective and are more applicable to the market. Additionally, high quality private institutions tend to be specialized in certain niches or courses, as will be discussed further.

This scenario yields a market that is not considered concentrated by any benchmarks. The CR_4 is below 40%, CR_8 is below 70%, and the HHI is well below 1.500 points. In fact, this scenario is interesting because it encompasses important regional

[39] All tables and figures with length bigger than one page can be found in the Appendix, at the end of the thesis.

players in the private sector as well as in the public sector, providing a glimpse into their competitive dynamics.

For example, PUC MINAS is the biggest provider in the state of Minas Gerais, with 4,6% of the southeastern market, well above UFMG's 3,26% (the second biggest player in Minas Gerais). This is important because usually the biggest players in a state are public institutions, and this shows a situation in which a private institution has the prestige and size to rival public institutions. In fact, Minas Gerais is a large state with many localized prestigious public institutions, outside of the capital, Belo Horizonte. For example, UFJF (1,85%), UFU (2,04%), UFV (1,38%), UFOP (1,21%), UFSJ (1,19%), and UFLA (1,01%) might all be considered substitutes, since they provide mostly the same courses, but are spread out between different sub-regions.

Turning to Rio de Janeiro, PUC-Rio is also considerably large, with a market share of 1,5%. However, Unicarioca is the biggest private player in the state, with 1,54% market share. As these institutions provide a wide array of courses, they do rival with big public institutions, but perhaps to a lesser extent, since market shares show that they are not able to capture as many students as the public institutions in the region. In fact, in Rio de Janeiro, UFRJ (4,6%), UFF (4,25%), UERJ (3,02%), and UFRRJ (1,64%) are the biggest players – all public – followed by Unicarioca (1,54%) and PUC-Rio (1,5%).

The biggest public players in the state of São Paulo are USP (5,38%), UNESP (3,74%), Unicamp (1,79%), UFABC (1,45%), UFSCAR (1,29%), and UNIFESP (1,1%). Located in the capital are USP, UNESP, and UNIFESP, as the other three (Unicamp, UFABC, and UFSCAR) are located in other large urban areas. Once again, there is a pattern of prestigious public universities spread out through the state, covering different geographic sub-regions.

The state of São Paulo provides an interesting insight into competition because of the existence of many relatively big private institutions. Examples are Uninove (14,1%), Mackenzie (3,04%), Unioeste (1,78%), PUC-SP (1,39%), and Uniararas (1,07%). Uninove may be an outlier case, as it is focused on mass education, which is usually related to lower quality. Nevertheless, with an IGC = 4, it makes the list.

These institutions offer a wider option of courses when compared to other private players and could rival public institutions. This group of institutions also presents considerable geographic capillarity, since only PUC and Mackenzie are placed in the

capital. On the other hand, there are other smaller, specialized private players, such as ESPM (0,46%) and FGV (0,29%), that are located in the capital and are particularly competitive when assessing the courses they offer.

Around 40,5% of students from private schools receive funding or aid. This number is quite elevated when one considers the size of this market. Also, it provides further support to the argument that private institutions can at least, offer aid and funding to students that are enrolling in schools. Therefore, in terms of student decision and its effect on market definition, one can argue that private and public schools can be seen as substitutes.

However, it is not clear whether the smallest private institutions have the capability of providing funding with such consistency. Also, it is hard to pinpoint student decision concerning the substitutability between a private IGC = 4 school and a public IGC = 4 school. In fact, on the one hand, smaller private institutions that are not as prestigious as the more established players may not be able to provide student support or may not be considered good substitutes to public institutions. On the other hand, the bigger private players tend to be less concerned with quality. Therefore, Table 8 puts forward the Southeastern high-quality public market.

Table 8 - Market 5: Southeast Market, Public Institutions. IGC = 4 & 5 (continues)

Institution	*Ownership*	*State*	*Students*	*Market Share*
USP	Public	SP	59.084	10,60%
UFRJ	Public	RJ	50.519	9,06%
UFF	Public	RJ	46.705	8,38%
UNESP	Public	SP	41.093	7,37%
UFMG	Public	MG	35.814	6,42%
UERJ	Public	RJ	33.208	5,96%
UFES	Public	ES	24.583	4,41%
UFU	Public	MG	22.363	4,01%
UFJF	Public	MG	20.353	3,65%
Unicamp	Public	SP	19.672	3,53%
UFRRJ	Public	RJ	17.959	3,22%
UFABC	Public	SP	15.888	2,85%
UFV	Public	MG	15.165	2,72%
UFSCAR	Public	SP	14.116	2,53%
UFOP	Public	MG	13.330	2,39%
UFSJ	Public	MG	13.104	2,35%
UNIFESP	Public	SP	12.095	2,17%
UNIRIO	Public	RJ	11.706	2,10%
UFLA	Public	MG	11.111	1,99%

Table 8 - Market 5: Southeast Market, Public Institutions. IGC = 4 & 5 (ends)

UFVJM	Public	MG	10.246	1,84%
IFSP	Public	SP	10.172	1,82%
UNIFEI	Public	MG	7.986	1,43%
CEFET/RJ	Public	RJ	7.879	1,41%
UFTM	Public	MG	7.332	1,32%
UNIFAL-MG	Public	MG	6.983	1,25%
IFES	Public	ES	6.865	1,23%
CEFET/MG	Public	MG	5.949	1,07%
IFRJ	Public	RJ	4.481	0,80%
IF SUL DE MINAS	Public	MG	4.385	0,79%
UENF	Public	RJ	2.158	0,39%
UEZO	Public	RJ	1.065	0,19%
ITA	Public	SP	814	0,15%
FAC-FEA	Public	SP	808	0,14%
FAMERP	Public	SP	683	0,12%
FAMEMA	Public	SP	642	0,12%
FMJ	Public	SP	594	0,11%
IME	Public	RJ	297	0,05%
EG	Public	MG	268	0,05%
Total			557.475	100,00%
CR4				35,41%
CR8				56,21%
HHI				531,94

Source: elaboration by the author based on data from INEP (2018).

Accounting only for public institutions, one sees that the biggest institutions are mainly located in metropolitan areas, especially for the small – in size – state of Rio de Janeiro, which shows no institutions outside of its metropolitan area. An interesting trend in São Paulo is the existence of many traditionally technical schools offering degrees at a bachelor's level.

Another interesting fact is the large concentration of students in the capital and dispersion of big institutions in other important cities of the São Paulo state. This tendency is even more intense in Minas Gerais, where UFMG is relatively small when compared to the big institutions of the other states, but Minas Gerais presents the highest number of relatively big institutions spread out through the state. Finally, UFES and IFES are the only schools in the state of Espírito Santo that fit this market, being comparable in size to secondary institutions in other states.

We see yet another non-concentrated market, with a CR_4 of 35,41%, a CR_8 of 56,21%, and an HHI of 531,94 points, raising no anticompetitive concerns. This table makes the distinction between the biggest, capital cities institutions, and other big but

regional institutions, easier. While the biggest institutions have well over 30.000 students, the others tend to vary between 10.000 and 30.000. Interestingly, one can argue for the existence of a competitive fringe, made of smaller institutions, with at most 6.000 students, especially in Minas Gerais and São Paulo.

The third geographic scenario is of national scope, accounting for public and nonprofit institutions with an IGC rating of five across the country – only 28 institutions, put forward in Table 9.

Table 9 - Market 6: National Market IGC = 5 (continues)

Institution	*Ownership*	*State*	*Students*	*Market Share*
USP	Public	SP	59.084	15,55%
UFRJ	Public	RJ	50.519	13,30%
UNESP	Public	SP	41.093	10,82%
UFMG	Public	MG	35.814	9,43%
UFRGS	Public	RS	35.108	9,24%
UFSC	Public	SC	30.283	7,97%
UFPR	Public	PR	26.354	6,94%
Unicamp	Public	SP	19.672	5,18%
UFABC	Public	SP	15.888	4,18%
UFV	Public	RJ	15.165	3,99%
UFSCAR	Public	SP	14.116	3,72%
UNIFESP	Public	SP	12.095	3,18%
UFLA	Public	MG	11.111	2,93%
FGV SP	Private	SP	3.149	0,83%
Insper	Private	SP	2.699	0,71%
UFCSPA	Public	RS	2.584	0,68%
FGV Rio	Private	RJ	982	0,26%
FCRN	Private	RN	808	0,21%
ITA	Public	SP	814	0,21%
SOCIESC	Private	SC	662	0,17%
FUCAPE	Private	ES	427	0,11%
IME	Public	RJ	297	0,08%
FAJE	Private	MG	228	0,06%
EST	Private	RS	240	0,06%
FIPECAFI	Private	SP	245	0,06%
FACEPD	Private	SP	151	0,04%
EEFTESM	Private	RJ	119	0,03%
FCC	Private	PR	92	0,02%
FATIPI	Private	SP	60	0,02%
Total			379.859	100,00%
Private Sector			9.862	2,60%
Public Sector			369.997	97,40%
CR4				49,10%
CR8				78,43%

Table 9 - Market 6: National Market IGC = 5 (ends)

HHI	916

Source: elaboration by the author based on data by INEP (2018).

Upholding these criteria are 29 institutions from three regions and nine states in the country. Notably, there is no institution in this category from the North and Midwest regions, and there is only one from the Northeast.

Here we have a fuller understanding of the high-quality higher education industry. The CR_4 equals 49,1%, which could characterize a concentrated market depending on the benchmark chosen, which is between 40 and 60%. The CR_8 equals 78,43%, higher than Bain's 70%. However, player size is much more balanced, as shown by an HHI of 916 points, making the national scope a non-concentrated market. This means that there are many players with similar market shares, especially between the seven biggest players (7% to 15%).

Another interesting fact is that the private sector holds only 2,6% of the market. The biggest private provider has 3.149 students, while the average public institutions has around 23.000 students. Thus, public institutions tend to provide greater quality and are able to provide a greater number of courses and maintain an elevated quality standard, while private institutions with an IGC rating of five tend to be specialized in certain areas of knowledge or in certain courses.

Albeit this is more common for private institutions, there are very small players, with less than 0,1% market share, in both public and private domains. Since this is a consequence of these institution providing only a few courses, usually in the same general area of knowledge, this can be interpreted as a tendency to **differentiate, or to specialize**, into specific niches. This will be further explored in section IV.3.2, according to the discussion on players' conduct.

V.2.2.3 Product Markets

In this section the focus will be upon specific product markets, combined with a national geographic scope, and the highest quality rating possible, that is, an IGC of five. The courses of Business Administration, Economics, and Law will be analyzed separately. These courses have been chosen because of their popularity amongst students, and because most of the highest quality rated schools offer them. That said, Table 10 begins the assessment with the HEIs that offer business administration courses:

Table 10 - Market 7: National Business Administration Courses (continues)

Institution	*Ownership*	*Students*	*Market Share*
FGV SP	Private	2.085	17,30%
UFRGS	Public	1.867	15,49%
INSPER	Private	1.459	12,11%
UFSC	Public	1.055	8,75%
UNICAMP	Public	1.011	8,39%
UFRJ	Public	962	7,98%
UNESP	Public	701	5,82%
UFMG	Public	521	4,32%
UFPR	Public	446	3,70%
UNIFESP	Public	381	3,16%
UFLA	Public	373	3,10%
UFSCAR	Public	315	2,61%
UFV	Public	289	2,40%
FGV RIO	Private	235	1,95%
FUCAPE	Private	211	1,75%
SOCIESC	Private	90	0,75%
FCRN	Private	50	0,41%
Total		12.051	100,00%
Private Sector		4.130	34,27%
Public Sector		7.921	65,73%
CR4			53,66%
CR8			80,17%
HHI			1002,66

Source: elaboration by the author based on data by INEP (2018).

We can see that this specification of the national market constitutes a much more concentrated one than when accounting for students enrolled in all courses within each institution, as shown in Market 6 (Table 9). Despite a relatively low HHI presenting 1002 points, with a CR_4 at 53,66%, and a CR_8 at 80,17%, this could be considered a concentrated market. The high CRs and a low HHI indicate that the market is also quite symmetrical. Additionally, the difference between the public and private sectors shares are much small, with 65,7% and 34,3%, respectively. Another interesting result is that UFRGS shows a quite relevant share of the market, with 15,49%, being the biggest public school in the Business Administration product market. FGV SP and INSPER dominate the market alongside other big public HEIs, while smaller private schools complete it. The case is not much different when considering the course of economics, summarized in Table 11:

Table 11 - Market 8: National Economics Courses

Institution	*Ownership*	*Students*	*Market Share*
UFRJ	Public	1.248	15,70%
UFSC	Public	935	11,77%
UFRGS	Public	916	11,53%
UFPR	Public	904	11,38%
INSPER	Private	830	10,44%
UNESP	Public	595	7,49%
UNIFESP	Public	419	5,27%
UFMG	Public	381	4,79%
UNICAMP	Public	372	4,68%
UFSCAR	Public	296	3,72%
UFV	Public	286	3,60%
FGV RIO	Private	233	2,93%
UFABC	Public	218	2,74%
FGV SP	Private	181	2,28%
FUCAPE	Private	133	1,67%
Total		7.947	100,00%
Private Sector		1.377	17,33%
Public Sector		6.570	82,67%
CR4			50,37%
CR8			78,37%
HHI			936,07

Source: elaboration by the author based on data by INEP (2018).

Once again, it is in fact a market with higher concentration than the full national market. The market's concentration ratios show a highly concentrated market, with the HHI being lower than the threshold of 1.500 points indicating that it is also highly symmetrical. Here, UFRJ is the biggest player with 15,7% market share, followed by UFPR, UFSC, and UFRGS, all in the 11% range. The biggest private player is INSPER, with 10,44%. Interestingly, the public sector has a much higher share and dominates the market of economics courses, with 82,7%. Let us see what the market for law courses shows is, as is presented in Table 12:

Table 12 – Market 9: National Law Courses (continues)

Institution	*Ownership*	*Students*	*Market Share*
FCRN	Private	54	0,57%
UFV	Public	318	3,36%
UFMG	Public	2.228	23,55%
UFLA	Public	672	7,10%
UFRJ	Public	3.010	31,81%
FGV RIO	Private	354	3,74%
UNESP	Public	695	7,35%
FACEPD	Private	151	1,60%

Table 12 – Market 9: National Law Courses (ends)

FGV SP	Private	365	3,86%
UFPR	Public	585	6,18%
UFSC	Public	1.029	10,88%
Total		9.461	100,00%
Private Sector		924	9,77%
Public Sector		8.537	90,23%
CR4			73,59%
CR8			94%
HHI			1870,75

Source: elaboration by the author based on data by INEP (2018).

The trend of higher concentration continues. In fact, this is the most concentrated of the three product markets, with 73,6% CR_4 and 94% CR_8, and a 1870 points HHI, indicating to a highly concentrated market. In addition to that, the share of the market the public sector holds is 90,2%, with UFRJ taking 31,8% of the market, and UFMG with 23,5%. The fact that the economics and law markets are more concentrated than administration and, specifically, that the public sector's share is higher, could be explained by the fact that these are disciplines that do not tend to generate a higher return to universities. Therefore, the private sector would not have a great incentive in providing them. Nonetheless, that is hard to measure.

V.2.3 Comparing Markets

Finally, Figure 5 summarizes the characteristics of all markets studied in section V.2:

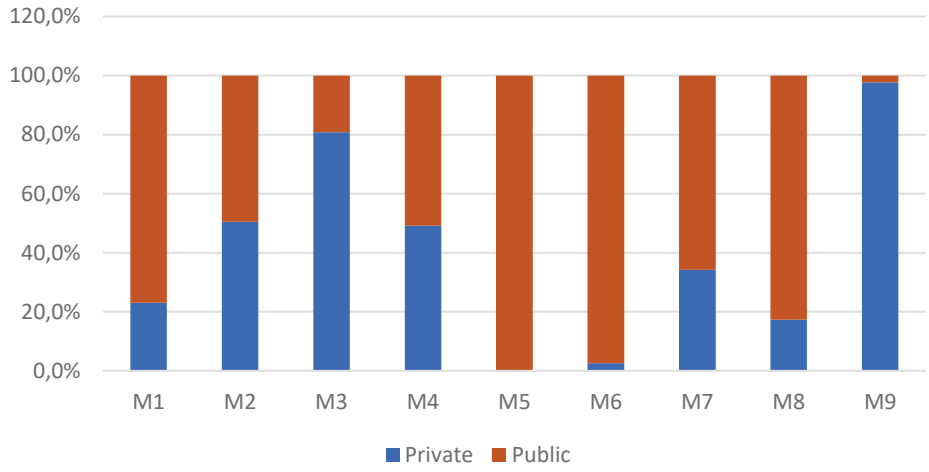
Figure 5 - Summary of All Relevant Markets

Market	Geographic Dimension	Product Dimension
1: Municipal RJ	City of Rio de Janeiro	IGC = 5 and 4
2: Municipal BH	City of Belo Horizonte	IGC = 5 and 4
3: Municipal SP	City of São Paulo	IGC = 5 and 4
4: Regional SE	Southeastern Region	IGC = 5 and 4
5: Regional SE - Pub	Southeastern Region	IGC = 5 and 4, Public
6: National	Brazil	IGC = 5
7: Business	Brazil	IGC = 5, Business Courses
8: Economics	Brazil	IGC = 5, Economics Courses
9 Law	Brazil	IGC = 5, Law Courses

Source: elaboration by the author.

It is quite interesting to see how these markets compare amongst each other regarding their indicators and composition. First, Figure 6 shows how the share of public institutions is quite varied between markets:

Figure 6 - Share of the Markets According to Ownership

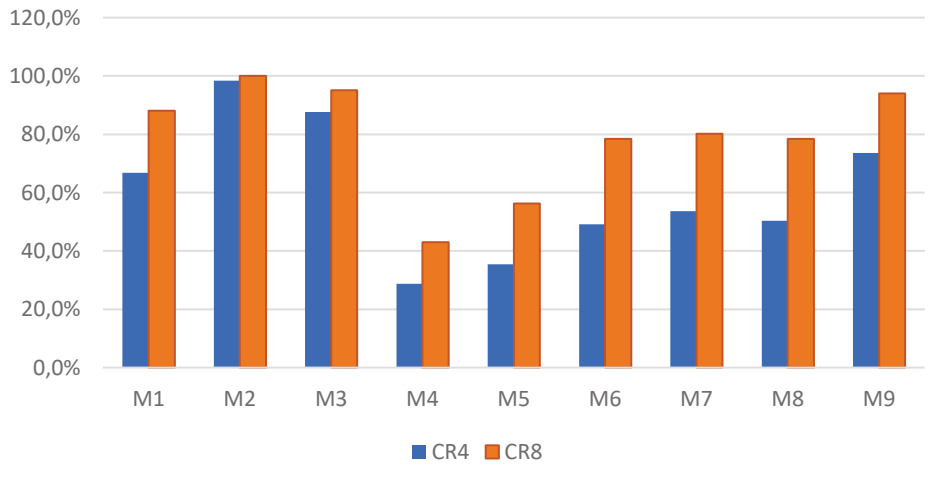


Source: elaboration by the author based on data by INEP (2018).

The notable exception is Market 6, the one with the highest quality and national scope, where the public sector holds 97,4% of the market (of course, excluding Market 5, which by definition accounts only for public institutions). This fact highlights the prestige and commitment to quality of the public sector in Brazilian higher education. Market 7 (national Business courses) and Market 8 (national Economics courses) are also quite public-led, once again highlighting the importance of public sector supply for certain courses.

These markets (Markets 6, 7, and 8), in addition to Market 4 (southeastern region) and Market 5 (southeastern region public schools) also tend to show the lowest concentration rates of all markets, as translated by Figure 7:

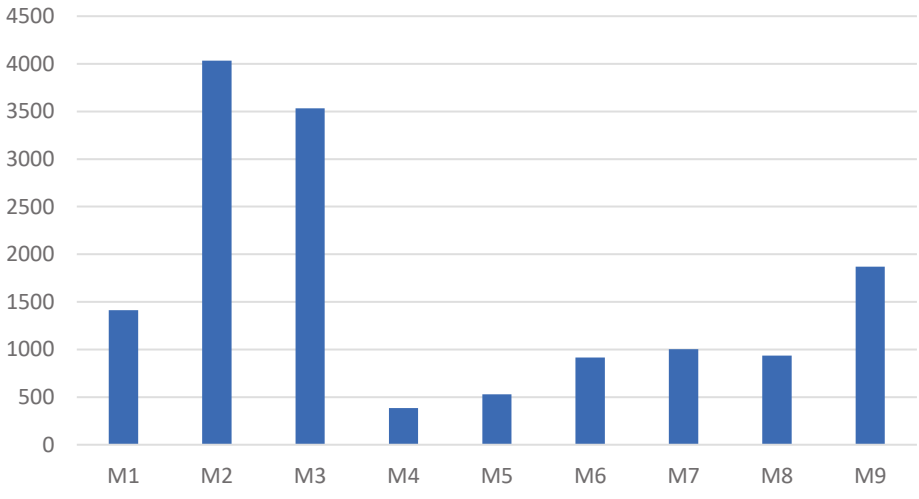
Figure 7: Concentration Ratios for Markets 1-9



Source: elaboration by the author based on data from INEP (2018).

That is in contrast with markets led by private institutions, which tend to be more concentrated. That trend becomes even clearer when assessing the HHI of each market, as provided by Figure 7:

Figure 8: HHI Index for Marktes 1-9



Source: elaboration by the author based on data from INEP (2018).

The only exception here is Market 4, which is quite balanced between the public and private sectors. Therefore, there is basis to conclude that markets that have a stronger presence of the public sector are usually less concentrated.

IV.2.4 Barriers to Entry

The reasons as to why potential competition is not a concern for incumbent institutions will be discussed. Structural barriers to entry will be discussed, followed by strategic barriers. The first reason is of legislative and regulatory nature, as has been exposed in the section regarding basic conditions.

At a first glance, **regulation** restricts entry as it requires considerable initial investment to satisfy faculty and infrastructure requirements, as it demands a certain level of quality. Not only that, but in the case of private institutions, accreditation by the Ministry of Education usually takes around two years. There are two possible scenarios of entry that present differences regarding how they are regulated. The first is the entry of an entity that does not offer any higher education courses. In that case, the bureaucracy involved takes much longer than in the case of an institution that already provides some

higher education course and intends to expand its operation. In that scenario, an institution could supply a new course in an already existing facility in a timely manner. However, expanding to new geographic markets would still be costly and slow. Therefore, in general, the process takes time and considerable investment in both situations, restricting a possible timely and competitive entry as a check to market power abuses.[40]

On the other hand, "entry" of public institutions leans heavily on the political landscape of the country, as these institutions must be created by law. So, while government leadership created several institutions in the 2000s, since then there has been little change as the consequence of a shift in the political environment of the country. It is now unthinkable that the current administration will create public institutions, considering it has vocally argued against them, even with talks of privatization. Therefore, it is justified to conclude that there will be no entry of public institutions, at least in the foreseeable future.

While **scale economies** constitute an indispensable factor for distance education markets, they are also quite relevant for presential markets, since institutions are still able to reduce average costs with facilities, infrastructure and teachers by increasing the number of enrolled students – to a certain extent. Bigger institutions also get better terms when negotiating financial contracts.[41] The regulatory requirements of infrastructure and quality are not unfounded – they stand on an economic theory base anchored precisely on the gains resulting from scale economies in the sector, and the following benefits to quality. In general, the growing demand in the sector and the absolute size of the market allow institutions to take advantage of these economies Weisbrod *et al.* (2008).[42]

In fact, advancing the results of the DEA models applied in section V.4, just by considering variable returns to scale, efficiency can be improved by 6% in the southeastern market. Scale efficiency in this market is found to be on the 93,3% mark, and 14 universities see an improvement in efficiency from a constant returns to scale to a variable returns setting.

---

[40] *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***

[41] *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***

[42] As a matter of fact, merging institutions always argue that the economies of scale resulting from the merger will ensue greater efficiency. The authorities have accepted this argument unless the merger raised other concerns in terms of abuse of market power.

Additionally, public institutions tend to be large not only because of the inherent bureaucracy of creating a new institution, but because they do benefit greatly from scale economies and from concentrating their activities in a single location or region. Therefore, economies of scale constitute an important characteristic of this market. On the other hand, the initial investment required to operate under a competitive margin could hinder the incentive to enter the market, especially when coupled with regulatory barriers.

That is especially true because a great share of the initial investment would be considered **sunk costs**, especially in terms of marketing. Quality and prestige have already been established as important competitive variables, and for a private player to enter the market competitively, marketing and "brand-building" would be primary concerns (Teodorovicz and Leandro, 2015). The reputation of established players in the industry has been built for decades, which on the one hand provides them with the resources required to carry out expensive publicity campaigns and on the other hand actually reduces the need for such campaigns.

Cade's jurisprudence on the private sector can be quite useful here. It has identified the – rather strict – conditions that would allow a timely and effective entry in the sector. First, there must be an institution that does not offer the course, with university autonomy in the geographic market in question; second, demand growth must be enough to accommodate a new player; third, teachers with master's and doctorate's degrees must not be in short supply in the region; fourth, the course is not in the areas of health, engineering and technology, or law.

Nonetheless, what happens quite frequently is that the schools' IGC rating varies through the years. For example, in 2016, only 28 schools had an IGC rating of five, while in 2018 there were 39, which points to considerable entry. If one considers the IGC rating of four and five, in 2016 the southeastern market would have 200 schools, in contrast with the 144 that met this criteria in 2018. In other words, there was a massive movement of exit in the sector when considering IGC of four and five. It is however unclear whether this process can be considered *de facto* entry, since the IGC index has been arbitrarily chosen as criteria for market definition and given its apparent volatile character.

Therefore, it is tricky to conclude something regarding barriers to entry. On the one hand, there are considerable entry costs and scale economies which hinder the entry of a new player in the sector – especially if this player wants to compete at the highest

quality levels. On the other hand, in this study markets are devised according to a quality index which has been revealed to be quite volatile, and the actual composition of the markets can change considerably from year to year.

V.3 Competitiveness and Conduct

This section has two objectives: first, to explore other traits of competitiveness in the industry, closely related to market structure but that are not explicitly laid out in the SCP paradigm, nonetheless having a significant impact on players' conducts; and second, to explicitly analyze conducts and players' actions and the competitive dynamics of the sector.

V.3.1 The Nature of Competition

Public institutions receiving subsidies can be considered stiffer in terms of their responses to market demands and financial for-profit incentives, since they are governed by a sense of building social value, not by market or shareholder values. Especially in the case of Brazil, as public institutions charge no tuition. This makes analyzing the sector with the two-good framework a bit tricky, but nonetheless still enlightening.

The first setback is that tuition is not the **main source of revenue for public institutions** in Brazil. Clearly, government funds constitute their first source of revenue.

If the pricing policy of institutions is a proxy of their incentives, the weight that the public sector puts on providing free high-quality higher education is a testament to its mission of wide access and equity.

It is interesting to note that public institutions' elevated degree of quality is common sense in the industry, which translates to high prestige. This is especially true if one considers the number of courses offered and the consistency with which public players provide a myriad of top-quality courses. There are 16 public institutions with a rating of 5 in the IGC, and the average number of courses supplied by them is of 56. On the other hand, although there are 22 private institutions with an IGC rating of 5, none of them provide more than seven courses. Once again, it is stressed that top-quality private institutions are specialized.

In fact, private institutions perceived as high prestige institutions are mostly non-profit (68% of private institutions with an IGC 5 rating), and they tend to concentrate in only a few courses. For example, the *Fundação Getúlio Vargas* (FGV), focuses on

economics, administration, social sciences, and law. On the case of IGC = 4, the *Escola Superior de Propaganda e Marketing* (ESPM) focuses on publicity, design and business. There is the rare case of prestigious non-profit institutions that are larger in size, mainly associated with the *Pontifícia Universidade Católica* (PUC), that holds *campi* in many capital cities and offers a diverse set of courses, or Mackenzie in São Paulo, with over 30.000 students.

However, perhaps the defining aspect of competition dynamics in the industry is the peer effects characteristic underlying the sector, so that the product is a service that requires considerable effort from the buying part to fulfill its objective, and that the final quality depends on the traits of consumers. This directly impacts the incentives of HEIs to capture the most able students, since the greater the student's ability, the more successful the institution will be in its mission. In fact, these incentives have a clear effect on how schools act, which will be explored in this next section.

V.3.2 Conduct

In terms of conduct, it is important to see how the environment affects players' incentives in the market. In that regard, peer effects are even more relevant for high-quality schools. For the private sector in general, there is a greater divide in terms of price, which reflects quality levels as well. Top private institutions usually charge much higher tuition than institutions with the lowest perceived quality, or mass institutions. Nonetheless, it has been established that high-quality institutions, mainly public and nonprofits, tend to compete for the best student in order to improve their own prestige and, consequently, attract better students.[43]

This makes the competition for the best students very fierce, and there are three main ways that institutions act to secure the best students for themselves: **through the selection process, through product differentiation, and through price discrimination.**

Regarding the selection process, despite the use of the ENEM (*Exame Nacional do Ensino Médio*) as the only admissions exam by many public institutions (47,3%), half (50%) of the schools analyzed here carry out independent exams. On the other hand,

[43] It is not clear whether this happens for low-quality for-profit mass institutions. It might be that their incentives are merely those of profit, therefore aiming at enrolling the highest possible number of students in their classes.

18,4% of schools use only independent exams – in other words, do not use ENEM in their selection process. Additionally, 28,9% of schools use both independent exams and ENEM as separate selection processes, while 7,9% of schools use ENEM and independent exams together in their process.

These exams vary in their model, and their objective is to exert dominance over the institution's region, as they apply these tests only locally and attempt to capture the region's best students. Table 13[44] summarizes the admission processes for public institutions in the southeastern market which have available data:

An interesting figure is that of institutions that apply only independent exams, accounting for 18,4% of the total. This conduct is justified by HEIs with an argument defending that ENEM's exam level is not suited to judge students' quality at the highest level. However, this limits the school's ability to capture students from outside of their region, since these tests are mostly localized. Therefore, applying only independent admissions exams would incur a trade-off between exerting local geographic dominance and capturing better students from distant regions. However, there appears to be no clear relation between the market share of a school and either the share of students admitted via independent processes, nor the share of students admitted via ENEM. Diving deeper into how these admission processes work and may differ, here are some examples.

Some universities apply only one multiple-choice exam, which is notedly the case of UFRGS[45] and UFSC[46]. Interestingly, these institutions also tend to reserve a greater share of their openings to their independent process, at 66% and 73,8%, respectively. This might be a way to give preference to local students while keeping the costs of applying these independent exams low. On the downside, this model might not accurately measure a student's capabilities, considering there is not a discursive test, or even a test focused on the subjects most pertinent to a student's course choice.

On the other hand, the University of São Paulo (USP)[47] applies its exam, organized by (and commonly referred to as) Fuvest, in two phases. The first exam has a value of 90 points, and it selects to the second phase a number of candidates that is proportionate to the number of openings. Then, students must undertake area-specific

[44] In the Appendix.
[45] See http://www.ufrgs.br/coperse/concurso-vestibular/vestibular-2021.
[46] See https://processoseletivo2021.ufsc.br.
[47] See https://www.fuvest.br/vestibular-da-usp/.

tests, and the best ranked students are able to enroll. USP was famously against the use of the ENEM as its main selection process, and reserves most of its openings to candidates of its own admission process – precisely 75,4% for the year of 2018. This can be seen as a commitment to quality and to getting the best students in its region, since Fuvest's tests are considered more difficult than ENEM.

A third model is applied by the Rio de Janeiro State University (UERJ)[48]. The exam occurs in two consecutive phases. The first phase consists of a multiple-choice test, with every major high school subject, that assigns a grade from A (if greater or equal to 70% correct answers) to E (if less or equal to 40% correct answers), and students get points according to their grade: 20 points for A, 15 for B, and so on, so that E yields zero points. The second test is a discursive exam focusing on the subjects most relevant to the course the student has applied for.

Utilizing a different model, the Federal University of Juiz de Fora (UFJF)[49], the independent admission process is carried out over the three years of high school for potential candidates. Students take a test at the end of each school year and are assigned a grade. The final grade considered for admission is composed of 20% of the first year's grade, 30% of the second year's grade and 50% of the third year's grade. Therefore, it is more of a long-term test, and gives candidates more opportunities to improve on their weak subjects. UFLA[50] uses a similar model, as students take tests at the end of the first a second years of high school but must take ENEM as the third grade.

What all these tests have in common is that they are localized. They're applied only in the city of the university and in nearby cities. Thus, these processes aim at securing the best students in the region of the university. This kind of exam can also be considered a second chance, in the case a good student has some problem or tough luck in the ENEM.

Universities that apply this type of exams might develop a close relationship with the best schools in the region, advertising their exam and encouraging students to take part. This is a clear way that universities attempt to capture the best students and exert geographic dominance.

---

[48] See https://www.vestibular.uerj.br/?page_id=7168.
[49] See https://www2.ufjf.br/copese/vestibular-pism-2/vestibular-pism-edicoes-anteriores/vestibular-pism-2019/.
[50] https://ufla.br/pas-ufla.

However, this could be seen as shady, or even as an anticompetitive conduct. Public universities were pressured to adopt the ENEM as their only admissions program in order to unify selection across the country. Institutions that have pushed against it and kept independent admission exams now have an upper hand at selecting the most qualified students.

It seems hard to fit Brazilian public institutions in a narrow concept of players seeking a geographic monopoly or oligopoly because there is an issue with their incentive. When a public HEI is commissioned to a city or region where there was previously no HEI of similar quality, this institution does not seek to explore a geographic location for profit; its mission is to provide quality higher education to a region where there previously were no institutions of such caliber. However, some public institutions potentially enjoy 'geographic market dominance', or at least some 'market dominance' resulting from their geographic location, especially in smaller cities and regions. They enhance this market power through independent selection exams. If these institutions do not actively exert market power, at least one can say that they face little geographic pressure – which is not ideal.

This does not happen only with the public sector. In fact, it is more common among private institutions. Almost every prestigious private university also carries out independent admissions exams, with the same intent. These institutions also divide their scholarships and grants between the ENEM and their independent exams, in order to encourage more students to take these exams. In fact, scholarships are offered in the basis of merit, usually for the best ranked candidates, and in the basis of socioeconomic needs, or both factors combined. Scholarships will be discussed later in this section.

The second strategy is to **differentiate**, in the meaning of specializing in a specific niche in terms of product market (Weisbrod *et al.,* 2008). This type of strategy is easier to observe in some of the elite private institutions, such as FGV and Ibmec, for example, that focus on economics and business, or ESPM, focusing on publicity and marketing. These are very prestigious institutions in the market – and arguably, this prestige comes from the fact that there is a specific focus and direction in their programs towards excelling in their respective areas.

This is also true for public institutions. ITA (*Instituto Tecnológico de Aeronáutica)* and IME (*Instituto Militar de Engenharia*) are perhaps the most

representative of this trend. These are renowned institutions, offering only courses in the field of engineering, ITA being even more stratified towards the aeronautics subject. Of course, one could argue that these institutions did not specialize as the result of a market strategy to be more competitive. However, the incentives behind that choice might differ, the end result seems to be the same: they are specialized in a certain area and the quality of their courses (and prestige of the institution) benefits greatly from that.

What seems more aligned to a "market" strategy for public institutions, in that sense, is when specific courses present a certain specialty. This specialization is commonly more intense on the graduate level, but it happens on undergraduate as well. This can be easily seen in the field of economics. Schools usually tend to be specialized in orthodox (mainstream, market-oriented approach) or heterodox economics (approaches outside the mainstream, usually based on Keynesian or Marxist economics). For example, while USP and FGV are highly regarded as prestigious orthodox schools, Unicamp and UFRJ are seen as prestigious heterodox schools.

The bottom line is that, at a certain point, a choice was made within these institutions to focus on a certain line of thought, or area of expertise, and therefore a quality differential was built in that subject for that university (of course, considering successful cases). That creates a differentiated product, which constitutes a classic way of attempting to attract more consumers.

Another important point that affects the competitive dynamics of the sector are scholarships given by private institutions, which can be considered **price discrimination.** This has gained importance especially in recent years when government funded programs have been slowing down. In such scenario, private universities are investing more in their own funding programs, in order to keep providing scholarships and attracting the best students. Only the biggest HEIs can keep offering scholarships at the same rate as before. Hence, they get a competitive edge.[51] Table 14[52] shows the percentage of students that get some sort of funding aid, specifically provided by the HEI they are enrolled in:

In addition to analyzing the share of students that receive funding from their HEI, it is important to look at the total number of students enrolled, as it might be related to

[51] *Anexo ao Parecer Técnico nº 1/2017/CGAA2/SGA1/SG/CADE* ***KROTON/ESTÁCIO, AC nº 08700.006185/2016-56.***
[52] In the Appendix.

the HEI's capacity to provide special funding. It also indicates that such schools are more fit to compete with public institutions, since they provide a greater range of courses, presenting higher substitutability with public HEIs.

Good examples of this are: the PUCs – PUC Minas with 50.472 students and 30,4% funding rate, PUC-Rio with 16.444 students and 29,2% funding rate, and PUCSP with 15.218 students and 12,6% funding rate; Mackenzie SP with 33.354 students and 24,1% funding rate; and ESPM with 5.073 and 18,8% funding rate.

On the other hand, smaller private schools with the highest IGC rating with a relatively high HEI-specific funding rating (say, close to or greater than 20%) could also be considered close competitors to public HEIs, since they usually specialize in a certain area or certain courses. This is the case of the courses provided by FGV, as the campus in Rio provides funding to 23,6% of its 982 students and the campus in São Paulo provides funding to 21,4% of its 3.149 students. Surprisingly, no other private school with an IGC rating of 5 has funding program initiatives.

However, it is worth noting that these private institutions also enjoy government funding programs, and the only ones that offer absolutely no funding aid in the National IGC = 5 market are FCC, FCRN, and SOCIESC.

Therefore, despite the apparent lack of incentives, public institutions carry out competitive action to attract the best students and differentiate their product. In addition to doing that, private institutions also discriminate in price with the same goals. Now, what is left is to check whether these conducts influence HEIs' performance.

V.4 Performance

Finally, this section assesses performance in the industry. In this section, the methods exposed in chapter IV.6 will be used. Specifically, the Charnes, Cooper, and Rhodes (1978) and the Banker, Charnes, and Cooper (1984) models of data envelopment analysis will be applied, both in output-oriented specifications. Different model specifications regarding the selection of decision-making units (DMUs) will be exposed, analyzed, and compared, with the goal of assessing differences in relative efficiencies between certain groups of HEIs. However, data specification and choice of variables will be discussed beforehand.

V.4.1 Data and Candidate Variables

All data refers to the year of 2018. Most of the candidate variables for the DEA model were taken from INEP's CENSUP, except for two output variables: scientific publications (PUB_SC), taken from the Web of Science platform, and patents and utility models (PATENT), taken from INPI. All variables were considered as input or output variables for the DEA model. Variables that were ultimately chosen for the model are indicated in bold with an asterisk. A list of all candidate variables is presented in Figure 9:

Figure 9 - Description of Candidate Input and Output Variables (continues)

Candidate Variable	*Type*	*Description*
STUD*	Input	Number of students enrolled in undergraduate presential courses.
ST_RES_GRANT	Input	Number of students with research grants.
ST_COMP*	Output	Number of graduated students.
PUB_SC*	Output	Number of scientific publications.
PATENT*	Output	Number of patents and utility models applied.
ST_DROP	Unclear	Number of students dropping out.
FACULTY*	Input	Number of teachers employed.
AGE	Input	Average age of teachers employed.
PHD*	Input	Number of teachers with a doctorate degree.
MA*	Input	Number of teachers with a master's degree.
PRES	Input	Number of teachers working in presential regime.
GRAD	Input	Number of teachers acting in graduate courses.
RESEARCH	Input	Number of teachers carrying out research activities.
FTE	Input	Number of teachers in a full-time exclusive regime.
FTNE	Input	Number of teachers in a full-time non-exclusive regime.
PART	Input	Number of teachers in a part-time regime.
HOUR	Input	Number of teachers in na hourly regime.
TEC*	Input	Number of technical administrative staff.
TEC_SUP	Input	Number of administrative staff with undergraduate degrees.
TEC_SPEC	Input	Number of administrative staff with specialization degrees.
TEC_MA	Input	Number of administrative staff with master's degrees.
TEC_PHD	Input	Number of administrative staff with doctorate degrees.
P_CAPES	Input	Dummy variable assessing if the HEI has access to Capes Journals.
VIRT_J	Input	Number of virtual journals the HEI has access to.
VIRT_B	Input	Number of virtual books the HEI has access to.
REV_OWN	Unclear	Revenue generated by the HEI's activities.
REV_TRANSF	Unclear	Revenue coming from governmental transfers.
REV_OTHER	Unclear	Revenue from other sources.
REV_TOTAL	Unclear	Total revenue.
EX_FAC*	Input	Expenditure with faculty's salaries.

Figure 9 - Description of Candidate Input and Output Variables (ends)

EX_TEC*	Input	Expenditure with administrative staff's salaries.
EX_TAX	Input	Expenditure with taxes corresponding to salaries of employees.
EX_GEN*	Input	Expenditure with activities related with the general function of the HEI.
EX_INV*	Input	Expenditure with investments.
EX_RES*	Input	Expenditure with research.
EX_OTH*	Input	Other expenditures.
EX_TOTAL	Input	Total expenditure.

Source: elaboration by the author. All variables are from INEP (2018) except for PUB_SC, which is from Web of Science (2018), and PATENTS, which is from INPI (2018).

ST_DROP was discarded at first glance, based on the fact it was not clear whether it should be considered an input or an output. All variables of revenue, own revenue (*REV_OWN*), revenue from transfers (*REV_TRANSF*), other revenue (*REV_OTHER*), and total revenue (*REV_TOTAL*) was not included because the expenditure variables signify better monetary representation of inputs, as expenditures with a specific purpose carry a more direct meaning, whereas revenue could be used in many ways. Total expenditure (*EX_TOTAL*) was not included since it is simply the sum of other expenditure variables.

Then, the remaining unused variables were dropped by running versions of the DEA model and assessing whether the incremental variable would change its outcome significantly. Some variables were expected to be significant but were not. That is the case of students with research grant (*ST_RES_GRANT*), teachers' age (*AGE*), administrative staff with PhDs (*TEC_PHD*), and administrative staff with master's degree (*TEC_MA*). Table 15 provides descriptive statistics for the chosen variables.[53]

As shown, standard deviations are usually very high for every variable, which reflects a high dispersion in the data. In fact, there are many institutions with a very low number of students (say, lower than 500), and a few with a very high number (say, greater than 30.000), while the mean is close to 8.000. Other variables tend to follow this trend.

One interesting fact is that scientific publications (*PUB_SC*) ranges from zero to 15.282, with a mean of 1.538,4 reflecting that there are many institutions focused solely on teaching activities. The same happens with patents and utility models (*PATENTS*), but to a lesser degree. This could suggest a need for separating universities between science-focused and teaching-focused when applying DEA. However, it could also be correctly

[53] In the Appendix.

dealt with by the DEA calculations, since teaching focused HEIs would have lower use of inputs. In fact, it would be expected that teaching focused institutions showed low (or zero) expenditure on research and investment, in addition to having a lower number of teachers with graduate degrees.

V.4.2 DMU Selection

In this section the selection of DMUs according to different model specifications will be discussed. Although analyzing a full model, with all available DMUs together, is indeed useful and provides interesting insight, the literature recommends the separation of DMUs into peer groups. In this thesis, the division is made according to the following criteria, as shown by Figure 10:

Figure 10 - Description of DMUs for each DEA Model

Model Nº	*Model Description*
Model 1	Full Model with all possible DMUs.
Model 2	Only public HEIs as DMUs.
Model 3	Only private HEIs as DMUs.

Source: elaboration by the author.

These models were run with the removal of outliers, but that did not change results significantly. Therefore, the choice was made to not present a model with outlier removal. That said, let's see how efficiency behaves under these different specifications.

V.4.3 Results

V.4.3.1 Model 1

Firstly, Model 1 is put forward. It is composed by 141 DMUs. It differs from the 148 institutions analyzed in chapter V.2.2 because some changes were made to make the data more fit to run a DEA model. First, FGV Rio and FGV SP were consolidated into one DMU; second, UNIFACEF, FERLAGOS, FMJ, and UNIFAE were removed from calculations because of missing values in some variables; third, the model was not able to calculate efficiency scores for ITF and FACESGRANRIO, because no outputs were produced in the period analyzed. The goals for Model 1 are to measure general efficiency in the industry, as well as comparing the relative efficiency of public HEIs to their private counterparts and assessing how each state in southeastern region performs.

For this set of DMUs, the output-oriented version CRS (Charnes, Cooper, and Rhodes, 1978) and VRS (Banker, Charnes, and Cooper, 1984) models were applied. The results are presented by Table 16.[54]

The average efficiency is relatively high in both specifications. Also, it is worth noting that all DMUs with a score of 1 also show zero slacks – in other words, are strongly efficient. Under constant returns to scale, an average score of 0,83 contrasts with an average score of 0,89 under variable returns to scale. In fact, a difference in efficiency of 6% highlights the importance of scale economies in the higher education sector. Calculating scale efficiency as the ratio of the CRS to the VRS model, an average scale efficiency of 93,3% is obtained, which is considerably high as well.

In total, the number of efficient HEIs under the CRS model is 75 (53,19%), and under the VRS model is 89 (63,12%), which is a bit far off the other studies analyzed previously. That difference can be explained by the inclusion of several small private institutions, while previous studies usually focused on federal HEIs.

In fact, the average efficiency of public institutions is higher than that of private institutions: for the CRS model, private HEIs show an average efficiency of 0,81 under CRS and 0,88 under VRS, while public institutions present efficiencies of 0,87 under CRS and 0,91 under VRS, the difference being of 6% and 3%, respectively. It is interesting to note that the difference in efficiency reduces significantly under variable returns of scale, suggesting perhaps that private institutions, while much smaller in average size, are managed in a way that aims to maximize scale economies. Nonetheless, while most inefficient institutions had their efficiency improved under VRS, there are six institutions whose efficiencies did not change under VRS, all private. They are UFTM (0,57 efficiency), ESDHC (0,56), IF Sul de Minas (0,95), ESPM SP (0,85), FACENS (0,12), and FTT (0,06).

Although average efficiency is high, there have been some private DMUs that were expected to be efficient – or at least more efficient than they were shown to be – but were not. FGV is perhaps the clearest example of this, with 0,76 efficiency under CRS and 0,78 under VRS. PUC-Rio, PUC SP, and ESPM have also been revealed as under performers. The first two, PUC-Rio and PUC SP, improved their scores considerably

[54] In the Appendix.

under VRS, since CRS scores showed efficiencies of 0,74 and 0,63, respectively. ESPM, on the other hand, showed the same scores under CRS and VRS.

However, measured inefficiency for some public institutions that possess high prestige and quality rates has been, perhaps, more shocking. UFRJ showed a 0,57 score under CRS, improving greatly under VRS to 0,74, but still very far from efficiency. UFJF had scores of 0,67 with CRS, improving significantly to 0,83 under VRS, but still lower than expected. UERJ performed even worse, with 0,52 and 0,69 scores. UNIRIO did not save the state of Rio de Janeiro either, with scores of 0,66 and 0,69.

Analyzing state by state, starting with *Espírito Santo,* under CRS there are nine efficient DMUs out of 14 (74,3%), and average efficiency was high, at 0,87. VRS efficiency was higher, at 0,91. Scale efficiency is also high, at 95,6%. UFES shows very low efficiency under CRS, with 0,63, improving to 0,83 with VRS. Out of the private institutions, FAESA, DOCTUM, UNESC, and FUCAPE were deemed inefficient. Nonetheless, general average efficiency was high, at 0,87 and 0,91 under CRS and VRS respectively, while the public averages were at 0,83 and 0,92, and private averages at 0,88 and 0,91. Interestingly, private institutions were more efficient than public HEIs under CRS, but that trend inverted under VRS. This could be explained by the very small average size of private institutions in this state, which therefore could not enjoy high economies of scale.

For the state of Minas Gerais, 22 out of the 40 DMUs were deemed efficient (55%) under CRS, and average efficiency was high at 0,86, and increased 4% to 0,90 under VRS. Scale efficiency, therefore, was also high, at 95,5%. As expected, UFMG, PUC-Minas, and other big public institutions were efficient. Out of the 18 inefficient DMUs, only four are public institutions: UFJF (0,67 CRS and 0,83 VRS), CEFET/MG (0,60 CRS and 0,61 VRS), UFTM (0,57 on both scores), and IF Sul de Minas (0,95 on both scores). The leap in efficiency from CRS to VRS shown by UFJF could be explained by its large size, as it would benefit more from economies of scale. The other 14 inefficient institutions are mostly small, private HEIs. Three HEIs were inefficient under CRS and were shown to be fully efficient under VRS, improving to 62,5% efficient HEIs: FAMA, changing from 0,99 to 1, FACAPA, from 0,72 to 1, and Faculdade de Administração de Cataguases, moving strangely from 0,25 to 1. Average efficiency increased 4% under VRS, to 0,90, a considerably high score. Public average efficiency was very high, at 0,91

and 0,93 under CRS and VRS respectively – the highest out of the four states – while private efficiency showed great improvement from CRS to VRS, going from 0,83 to 0,89.

For the state of Rio de Janeiro, average efficiency under CRS is by far the lowest out of all states, at 0,77. There is a considerable improvement of 8% under VRS, to 0,85. Nonetheless, the state of RJ is by far the least efficient out of the southeastern states. Scale efficiency, while high in general, was also the lowest, at 90,5%. Out of the big public *carioca* institutions, UFF and UFRRJ were the only ones that showed full efficiency, with scores of 1 in both specifications. Also, IME has also obtained full efficiency.

As has been said before, UFRJ, UERJ, and UNIRIO did not perform well. In fact, out of the 24 DMUs, 11 were deemed inefficient under CRS, the worst rate of all states at 45,8% efficient HEIs. In addition to UERJ, UFRJ, UNIRIO, and PUC-Rio being inefficient, ESPM RJ showed very low efficiency, at 0,51 and 0,55 under CRS and VRS respectively. Nonetheless, four more HEIs were shown to be efficient under VRS, improving to 62,5% efficient DMUs: EEFTESM from 0,63, CEFET/RJ from 0,77, UNICARIOCA from 0,99, and IFRJ from 0,48. While public average efficiency under CRS was relatively low at 0,80, it improved greatly under VRS to 0,91. Private efficiency was even lower, at 0,74 and 0,80 under CRS and VRS respectively.

Finally, the state of São Paulo showed that 33 out of the 62 (53,22%) institutions were efficient under CRS, and the average efficiency was 0,82. Under VRS, efficiency increased to 0,89, and scale efficiency was at 92,1%. All prestigious public HEIs showed an efficiency score of one under both specifications: USP, Unicamp, UNESP, UNIFESP, and ITA. Unexpected inefficient institutions are found in PUCSP and ESPM. The massive UNINOVE, with more than 154.000 students, was found efficient under both specifications as well. Nonetheless, efficiency under VRS was considerably higher – specifically, 7% higher – at 0,89. In fact, seven institutions that were not efficient under CRS were shown to be efficient with VRS, turning the share of efficient DMUs to 64,5%.

While there is a 10% difference in efficiency between the public and private sector under CRS, at 0,90 and 0,80, respectively, this difference decreases greatly under VRS, since the public average is at 0,91 and the private sector averages a score of 0,89. This potentially shows that the private sector in São Paulo might explore economies of scale more efficiently relative to the public sector. Nonetheless, this does not erase the fact that

public sector efficiency in São Paulo is high, and its prestigious public institutions are all fully efficient.

V.4.3.2 Model 2

Model 2 considers the 37 public HEIs that are present in Model 1. The difference between these two models is that, while DEA measures relative efficiency, in Model 1 the efficiency of all institutions is being measured against one another. Model 2 assesses only one kind of DMU, which is called by the literature a "peer group", composed of similar DMUs to be compared amongst themselves. While one of the goals of Model 1 was to assess how public institutions compare to their private counterparts, Model 2 aims to measure how public HEIs perform relative to one another. Table 17[55] shows the efficiency scores for Model 2.

Average efficiency is high under both specifications, at 0,90 with CRS and 0,96 with VRS, and the slacks of all efficient DMUs are zero – therefore, all are strongly efficient. Scale efficiency, as measured by the ratio of average CRS scores to average VRS scores, is at 93,75%, only marginally higher than Model 1's.

The number of efficient DMUs under CRS is 26, with a ratio of 70,3%. Presenting first the CRS scores, then the VRS scores, the inefficient DMUs under CRS and/or VRS are: UFES with 0,76 and 0,98; UFJF with 0,95 and 1; CEFET/MG with 0,63 and 0,65; UFTM with 0,63 and 0,8; UERJ with 0,68 and 0,97; UFRJ with 0,72 and 0,91; CEFET/RJ with 0,77 and 1; UNIRIO with 0,67 and 0,84; IFRJ with 0,48 and 1; FAMEMA with 0,97 and 1; and IFSP with 0,16 and 0,3. First, it is gathered that, under VRS, the number of efficient DMUs goes up to 30, with a share of 81,1%.

One very interesting fact here is that, while public institution average efficiency is indeed higher than private institution average efficiency in Model 1, Model 2 shows that the public institutions that are inefficient, when compared only with public institutions, have higher efficiency scores. In fact, the only inefficient DMUs whose scores have not increased from Model 1 to Model 2 are CEFET/RJ and IFRJ, two out of 11. In some cases, the increase is rather significant. For example, UFJF's scores went from 0,67 and 0,83 in Model 1 to 0,95 and 1 in Model 2 under CRS and VRS respectively; UFTM's went from 0,57 and 0,57 to 0,63 and 0,80; UERJ's went from 0,52 and 0,69 to

[55] In the Appendix.

0,68 and 0,97. In other words, a difference that can reach as high as 30% efficiency under VRS for some cases.

This is a tricky result to interpret, since these two pieces of information seem to lead to different conclusions about the same set of DMUs. On the one hand, when compared to their private counterparts, the average efficiency of public HEIs is higher than that of private institutions. That suggests that public HEIs are more efficient. On the other hand, when compared only amongst themselves, public HEIs present higher average efficiency. Especially, the inefficient DMUs show higher efficiency when compared only to public institutions. That suggests that private HEIs are more efficient. Perhaps, Model 3 might shed some light on the matter.

V.4.3.3 Model 3

Model 3 considers the 104 private HEIs present in Model 1. In similar fashion to Model 2, the goal here is to compare the efficiency of private HEIs relative to their peers. Then, it is aimed to compare the efficiencies under this specification to the efficiencies under the specification of Model 1. With that in mind, Table 18[56] presents the efficiency scores for Model 3.

Average efficiency under CRS for Model 3 was 0,85, while the VRS score was 5% higher at 0,90. Scale efficiency was high at 94,4%. In fact, high scale efficiency seems to be a trend in the sector as whole. Under CRS, 55 out of 104 (52,9%) DMUs were fully efficient, and under VRS this number grew to 69 DMUs (66,3%).

Interestingly, some DMUs that were expected to be efficient have fallen short. Most notedly, FGV with 0,77 and 0,80 CRS and VRS scores, respectively, as well as ESPM with 0,93 and 0,98 and ESPM RJ with very low scores at 0,51 and 0,56. Impressively, 14 HEIs that were not efficient under CRS have obtained a score of one under VRS – some making a rather large jump: Faculdade de Administração de Cataguases (0,25 to 1), ISA Vera Cruz (0,24 to 1), and FCI (0,32 to 1) are cases that perhaps require further analysis to be fully understood.

When compared to Model 1, 26 of the private HEIs had at least one of their scores worsened, and none has improved. Once again, this brings the paradox of a higher average score for public HEIs, but that the inefficient public HEIs are relatively less efficient than

[56] In the Appendix.

the inefficient private HEIs. In other words, the presence of the inefficient public DMUs in the analysis makes the inefficient private DMUs seem more efficient than when the private DMUs are compared only amongst themselves – even if average private efficiency is smaller than average public efficiency.

V.4.3.4 Comparing Results

Finally, it is worth analyzing each model's results against one another. Therefore, Table 19 puts forward model specifications and average scores for each model:

Table 19 - All Models Summary

Variables/Specs	***Model 1***	***Model 2***	***Model 3***
Public HEIs	*X*	*X*	
Private HEIs	*X*		*X*
n	141	37	104
CRS Average	0,83	0,90	0,85
VRS Average	0,89	0,96	0,90
Scale Efficiency	0,933	0,938	0,944

Source: elaboration by the author based on data from INEP (2018), INPI (2018), and Web of Science (2018).

The lowest average efficiency is found in Model 1, the full model, at 0,83 and 0,89 CRS and VRS scores, respectively. Model 2, comprising only public HEIs, has the highest efficiency of all models, with 0,90 and 0,96 CRS and VRS scores respectively. Model 3, with only private HEIs, is the intermediate one, with scores of 0,85 and 0,90 CRS and VRS efficiency, respectively. The considerable differences between a constant return to scale and variable return to scale specification highlights the importance of scale economies in the sector. It has been shown to be enjoyed by both public and private institutions alike, with many DMUs improving their scores under VRS. Scale efficiency is high and very close in all three models: 93,3% in Model 1, 93,8% in Model 2, and 94,4% in Model 3, which would suggest that private institutions show marginally higher scale efficiencies.

Notwithstanding, it is not as simple as ranking the models. We must remember that DEA measures efficiency only *relative* to other DMUs in the model. However, this information can still be useful. For example, we know that public HEIs have a higher average efficiency than private institutions in the full model. Nonetheless, there are some big public institutions with very low efficiency scores – especially in the state of Rio de Janeiro.

When these institutions are compared only with other public institutions, they show higher efficiency than when compared to their private counterparts. This happens for nine public institutions: UFES, UFJF, CEFET/MG, UFTM, UERJ, UFRJ, CEFET/RJ, UNIRIO, and IFRJ.

Therefore, one could conclude that, while average efficiency is higher for public institutions, there are a handful of public institutions that not only are not efficient when compared to their peers but are even less efficient if compared to their private counterparts. This is even more interesting when one considers the fact that most of these institutions, particularly the universities, are deemed as top-quality higher education centers, with great focus on research and a great pull on students.

Nonetheless, efficiency is indeed high in all models, and only a few DMUs are below 0,80 scores. When one considers the classic argument that private *players* tend to be more efficient than public, these results show otherwise. While the difference might not be great, the fact is that when comparing public and private *players,* average public efficiency is higher.

There are, of course, public and private institutions with low efficiency. More importantly, there are DMUs with very low scores, some even lower than 0,1. Exploring how these HEIs could improve their efficiency scores constitutes too difficult a task for this thesis, but it appears feasible for future work. For now, conclusions will be offered based on everything that has been shown so far.

VI Conclusions

The main goal of this thesis was to gauge competition in the Brazilian higher education industry, with focus on the high-quality public sector. This industry differs from traditional markets because of its many peculiarities, which were all recognized and mostly dealt with to provide an analysis that is the closest to reality. For that, many contributions of the Industrial Organization field have been exposed as the basis to understanding this sector.

The **Structure-Conduct-Performance** (SCP) Paradigm has been used as the baseline to the assessment of important competition variables in the industry, following the trend of antitrust authorities around the world. First, the Paradigm's general framework and its main variables were exposed, with the relationship between them

discussed. Each of the variables were deeply analyzed separately, having in mind the objective at hand. Next, market power, welfare and antitrust practices were discussed. While making judgements regarding market power or market power abuse in the industry is not the goal here, they are useful concepts to gauging competition. Nonetheless, the term 'market dominance' has been preferred, since it does not carry the meaning of a potential price increase that comes with 'market power'.

To make proper use of the analytical framework exposed above, the higher education industry's characteristics and peculiarities were scrutinized. The specificities of knowledge production and sharing are analyzed, its positive externalities were highlighted, and its public good character is explored. Next, the benefits higher education brings were exposed, and its relation to the (lack of) incentives in the private sector to produce it were discussed. The public sector comes as the problem-solver to the issue, aiming to maximize the social return, knowledge production and diffusion, among other results of higher education. The mission of private and public institutions was also discussed, and the causality between the market failures in the sector and the difference in incentives for private and public players was explained. Finally, competition in markets with mixed ownership was discussed. There is evidence supporting the conclusions that the presence of public players increases total output and social welfare, even in differentiated markets – except in some specific situations. In fact, the two types of institutions can be complementary as a result of their different missions. On the one hand, public higher education institutions (HEIs) will favor the production of research and the supply of courses that might show little financial return. On the other hand, private institutions will focus on offering courses and producing more applicable knowledge (in the industrial sense) with a higher financial return.

Indeed, this tendency can be explained by the two-good framework. First and foremost, HEIs provide education and charge tuition. Therefore, they compete mainly for students and geographic markets because tuition constitutes their main source of income. Nonetheless, because of their mission, these institutions are charged with providing (and creating) other goods, which may not have financial returns. The public and non-profit players tend to focus more on mission goods, while for-profit players are basically concerned with revenue goods. However, there is always the concern of achieving a balance between revenue goods and mission goods.

As a method of measuring performance in a non-traditional, multi-product market, **Data Envelopment Analysis** (Charnes, Cooper, and Rhodes, 1978; Banker, Charnes, and Cooper, 1984) is the most indicated for the case in hand, and its model's specifications are exposed.

Then, an empirical review was carried out, aimed at identifying and assessing papers that have contributed to the subject of analyzing the higher education industry under the scope of Industrial Organization. There are two defining aspects inherent to higher education that help us draw the lines of competition in the sector: peer effects and information asymmetry. Peer effects work in the direction of always pushing HEIs to seek enrolment of the best students, since the overall and perceived quality of a university depends on the quality of its students. This is also important for students deciding between institutions. Information asymmetry regarding service quality, on the other hand, happens because higher education is an experience good, therefore precisely measuring its quality is tricky. Students and HEIs resort to rankings and quality indexes which generally are indexes composed of several observed metrics and proxies, but rarely a direct measure of quality or performance.

In terms of the definition of relevant markets, it is important to be aware of some prominent factors, such as defining the exact object of study, identifying substitutes, defining geographic markets, identifying potential competition, and accounting for suppliers (vertical relationships). Barriers to entry also influence in relevant market definition, and they are quite strong in the sector. Regarding conduct, price discrimination and product differentiation are the trends identified in the sector.

An empirical review on the applications of DEA in higher education concludes that most papers dealing with the subject are limited either by their DMU choices or by their choices of inputs and outputs. Therefore, there is a gap to be explored in the literature, by using richer data sets and seeking better variables to use as inputs and outputs.

Finally turning to the assessment of competition of the Brazilian higher education sector itself, the data used in this thesis stems mainly from the Higher Education Census (Censo da Educação Superior, CENSUP) provided by INEP. Data from admissions is also used from the SISU, from INEP as well. Data from patents has been gathered at INPI, while data from scientific publications was gathered at Web of Science.

Basic conditions of supply and demand are the first items in the SCP paradigm. In terms of supply conditions, legislation and regulation in the sector are very strong, causing high barriers to entry. Also, scale economies are relevant in the sector, pointing to a potential tendency of concentration. In terms of demand conditions, since the public sector charges no tuition, it is difficult to measure some usual parameters. However, this opens the arena for competition in other variables, such as quality. In general, demand for higher education has been increasing greatly over the last decades. This growth is accounted for mostly by the private sector, but the public sector has also increased its size and capillarity. However, only presential courses of bachelor's or licensure undergraduate degrees have been considered in the analysis.

Turning to **market structure, relevant markets** are defined to comprise a feasible competition spectrum, both in terms of product and geographic competition. The definition chosen here is that of undergraduate, presential courses in universities of high, similar quality, considering the potential geographic pull of certain groups of HEIs. This definition yields three different relevant market scopes: firstly, a municipal market of HEIs of an IGC quality rating of four and five for the cities of Rio de Janeiro (Market 1), Belo Horizonte (Market 2), and São Paulo (Market 3), accompanying the jurisprudence of the Brazilian antitrust authority; second, a regional market, comprised of HEIs from the southeastern region of Brazil, with an IGC quality rating of four and five, under two specifications – private and public HEIs together (Market 4), and only public HEIs (Market 5) –; third, a national market for institutions of the highest quality, an IGC rating of five (Market 6).

Starting with the municipal markets, Market 1 (city of Rio de Janeiro) shows a picture of a concentrated market, albeit not symmetrical, with the HHI below the anticompetitive thresholds. Public players lead the market, with approximately ¾ of students, with UFRJ and UFF being by far the biggest players. Market 2 (city of Belo Horizonte) shows a different scenario, that of a definitively concentrated market, with all concentration indexes way above their respective thresholds. PUC MINAS and UFMG, together, nearly constitute a duopoly. However, the share of public and private institutions is balanced, with close to half for each. Market 3 (city of São Paulo) is also highly concentrated, with all its concentration indexes above their respective thresholds. UNINOVE has more than half of the market, making it very asymmetrical. Therefore, municipal markets are highly concentrated, and somewhat varied in their composition.

Market 4 (private and public HEIs with IGC = 4 and 5, southeastern region) shows a more balanced market. While public and private institutions hold nearly 50% market share each, the number of private institutions is much larger, and their average size is consequently much smaller. The market is not considered concentrated, with all concentration measures below their respective benchmarks. Also worth noting is that there are big and diverse private HEIs that can rival with their public counterparts, both in terms of quality and in terms of the number of courses provided. Nonetheless, the presence of small and rather specialized private institutions raises the question that perhaps this is not a feasible specification.

Therefore, Market 5 (southeastern region, public institutions) provides important insight. First, big public universities tend to be concentrated in metropolitan areas. The exception is in the state of Minas Gerais, that shows more dispersion with its universities. Second, the market is still not concentrated, with all concentration indexes far from their respective thresholds. Third, while there are some institutions with more than 30.000 students, and many between 30.000 and 10.000, there is also a number of prestigious HEIs with around 6.000 students or less, that could constitute a strong competitive fringe, especially in MG and SP.

Finally, Market 6 (national scope with highest quality) shows a market with relatively high concentration ratios, which could raise concerns – albeit for the fact that the eight biggest institutions are public, and the market is not very symmetrical. Here, the private sector holds only 2,6% of the market, a dramatically low number, which points to the fact that the absolute highest quality market is dominated by public institutions.

Closing the topic of concentration, **barriers to entry** are indeed elevated because of strict legislation and regulation in the sector, as well as the presence of scale economies and sunk costs, which increase barriers to entry. Interestingly, while scale economies are large, it is relatively hard to find big private players, which would in theory benefit more from these economies. What is seen is that public HEIs' average size is in fact much larger, perhaps a testament to the need of public intervention in the industry. Nonetheless, since one the criteria for market definition in this thesis is somewhat arbitrary (the IGC quality rating), the number of institutions could vary considerably from period to period.

Opening the **conduct** section, one sees that quality and prestige are the main variables of competition. Schools compete for students, that make their choice primarily

based on an institution's quality – or perceived/observed quality: prestige. However, in the competition for students, HEIs are also looking for high-quality students, because of peer effects. Therefore, the main conducts carried out by HEIs in an attempt to attract the better students are the selection process, product differentiation, and price discrimination.

In fact, 50% of schools in the southeastern region carry out **independent admission processes**. These processes usually consist of a localized exam, in an attempt to capture the best students in the proximities of the HEI. When combined with the ENEM, it could be a relevant tool attempting to exerting a more localized dominance. In terms of total enrollment (considering all schools in the country), the majority of students enter HEIs through independent exams.

This is perhaps the most important part within the SCP paradigm analysis for this study, because it does not just show how basic conditions affect the dynamics of an entire market, but because it shows how **conduct can affect structure and performance. It also demonstrates how fiercely institutions compete amongst themselves for students**, especially concerning competition public and private players. Applying an independent admissions process signals that a school wants to act and to guarantee the best students in a particular geographic area, usually in its own city, but commonly in a state-wide fashion.

Product **differentiation** or specialization is a strategy seen most commonly amongst private players, that have incentives to specialize in sectors with higher financial returns, also attempting to differentiate their courses and attract more students.

Price discrimination, here seen as the provision of scholarships or funding aid to students, is the final trend of conduct identified. In fact, almost half of students in private schools in Market 4 (southeastern region) receive some sort of funding or grant. This can be considered a strong argument in favor of the high substitutability of high-quality private HEIs with high quality public institutions, since it reduces or eliminates the price differential between them.

Finally, **performance** in the industry has been assessed via DEA models. Three models were estimated, Model 1 being a full model with all DMUs, Model 2 accounting only for public HEIs, and Model 3 accounting only for private HEIs.

Average efficiency for all models was lower than expected when comparing with previous works. Nonetheless, public institutions were found to be on average more efficient than private institutions. Considerable efficiency gains are seen under variable returns to scale, which points to the importance of economies of scale in the sector. Some prestigious public schools, especially in Rio de Janeiro, have shown efficiency well below expected levels.

Inefficient public schools show a higher score when compared to their peers than when compared with private schools. This means that while the average public HEI is more efficient than the average private HEI, the odd inefficient public school tends to be less efficient than the inefficient private school. More than that, when present, the inefficiencies of public schools are even more clear when they are compared to private schools. In fact, while public HEIs have greater average efficiency, the odd inefficient public schools is indeed very low on efficiency, which makes inefficient private schools seem more efficient then when they are compared solely to their peers.

Finally, the process of producing this thesis has been very tricky and arduous. Exploring a non-traditional market with Industrial Organization framework as a classic background and some other not so straightforward methods has been tiring but rewarding. It is incredible to see how we can account for complex dynamics and non-traditional competition and make satisfying advancements to the understanding of such an industry. Personally, I believe that there is much more to deepen within this topic, and this is just the outline of a wider and more precise understanding of the sector. Nonetheless, it is very satisfying to see that, even in the absence of price, in a sector with great traditions and where prestige really takes a major role for student's choice, the schools compete for students and adopt conducts to actively attract the better students.

Another fascinating insight from this work is how the public sector presence is paramount for the industry's development. The lack of incentive from the private sector to provide higher education at a top-quality level is no doubt shown in the figures of National Market. Public schools offer a much wider range of courses, have much more students in average, and produce more scientific publications and patents. And that must not be underestimated. Even when public schools show lower efficiency scores, their impact on society and the economy is much greater than problems in their allocative efficiency and their expenditures. Of course it would be beneficial to try and attain better

efficiency levels, but the position of some to simply attack public institutions based solely on the grounds of efficiency is simply misled.

There are many possible avenues for further exploration on the subject. For example, one can assess different market specifications, such as including or studying only online courses, or focusing on the private education sector and its specificities. Another option would be to analyze graduate programs across the country and see if there are considerable differences to these results. Finally, one can attempt to connect the efficiency scores to the differences in input variables across institutions, in order to make policy recommendations.

References

Alm, J., & Winters, J. V. (2009). Distance and intrastate college student migration. *Economics of Education Review*, *28*(6), 728-738.

Alves, M. F. (2019). Média salarial do brasileiro é quase três vezes maior quando se tem Ensino Superior. *Quero Bolsa*. Accessed 29 March 2020, https://querobolsa.com.br/revista/media-salarial-do-brasileiro-e-quase-tres-vezes-maior-quando-se-tem-ensino-superior

Athanassopoulos, A. D., & Shale, E. (1997). Assessing the comparative efficiency of higher education institutions in the UK by the means of data envelopment analysis. *Education economics*, *5*(2), 117-134.

Avery, C., Glickman, M., Hoxby, C. M., & Metrick, A. (2004). A revealed preference ranking of US colleges and universities.

Bain, J. (1956). Barriers to new competition: The character and consequences in manufacturing industries. *Harvard University Press.*

Bain, J. (1959). S. Industrial organization. *New York and London*.

Baker, J. B. (2007a). Beyond Schumpeter vs. Arrow: How antitrust fosters innovation. *Antitrust Law Journal*, *74*(3), 575.

Baker, J. B. (2007b). Market definition: An analytical overview. *Antitrust Law Journal*, *74*(1), 129-173.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science*, *30*(9), 1078-1092.

Banker, R. D., Cooper, W. W., Seiford, L. M., & Zhu, J. (2011). Returns to scale in DEA. In *Handbook on data envelopment analysis* (pp. 41-70). Springer, Boston, MA.

Becker, W. E., & Round, D. (2009). The Market for Higher Education: Does It Really Exist? *Institute for the Study of Labor (IZA),* Discussion Paper No. 4092.

Brazil (1996). Lei das Diretrizes e Bases da Educação Nacional. Lei 9.394/96. *Casa Civil, Subchefia Para Assuntos Jurídicos.* Accessed 11 November 2020, http://www.planalto.gov.br/ccivil_03/leis/l9394.htm

Brazil (2011). Lei da Defesa da Concorrência. Lei 12.529/11. *Casa Civil, Subchefia Para Assuntos Jurídicos.* Accessed 24 September 2020, https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/lei/l12529.htm

Brazil (2014). Plano Nacional de Educação. Lei 13.005/14. *Casa Civil, Subchefia Para Assuntos Jurídicos.* Accessed 11 November 2020, http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l13005.htm

Bresnahan, T., Schmalensee, R. (1987). The Empirical Renaissance in Industrial Economics, Oxford: *Basil Blackwell.* Reprint of a special issue of the Journal of Industrial Economics, 35(4), pp.1-19.

Campbell, R., & Siegel, B. N. (1967). The demand for higher education in the United States, 1919-1964. *The American Economic Review*, *57*(3), 482-494.

Cavalcante, S. M., & Andriola, W. (2012). Avaliação da eficiência dos cursos de Graduação da Universidade Federal do Ceará (UFC) através da Análise Envoltória de dados (DEA). *RIEE. Revista Iberoamericana de Evaluación Educativa*.

Caves, R. E. (2007). In praise of the Old IO. *International Journal of Industrial Organization*, *25*(1), 1-12.

Chamberlin, E. (1933) The Theory of Monopolistic Competition. Cambridge, MA: *Harvard University Press*.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, *2*(6), 429-444.

Conselho Administrativo de Defesa Econômica (Cade). (2016). Guia para análise de atos de concentração horizontal.

Cooper, W. W., Seiford, L. M., & Zhu, J. (2011). Data envelopment analysis: History, models, and interpretations. In *Handbook on data envelopment analysis* (pp. 1-39). Springer, Boston, MA.

Costa, E. M., Ramos, F. D. S., Souza, H. R. D., & Sampaio, L. M. B. (2015). Dinâmica da eficiência produtiva das instituições federais de ensino superior.

Cremer, H., & Maldonado, D. (2013). Mixed Oligopoly in Education. *IZA Discussion Paper No. 7264.*

Cremer, H., Marchand, M., & Thisse, J. F. (1991). Mixed oligopoly with differentiated products. *International Journal of Industrial Organization*, 9(1), 43-53.

Daskin, A. J. (1991). Deadweight loss in oligopoly: a new approach. *Southern Economic Journal*, 171-185.

De Fraja, G. (2009). Mixed oligopoly: old and new. *University of Leicester Working Paper No. 09/20.*

De Fraja, G., & Delbono, F. (1987). Oligopoly, public firm and welfare maximization: a game-theoretic analysis. *Giornale degli Economisti e Annali di Economia*, 417-435.

De Fraja, G., & Delbono, F. (1990). Game theoretic models of mixed oligopoly. *Journal of Economic Surveys*, *4*(1), 1-17.

Dias Sobrinho, J. (2013). Educação superior: bem público, equidade e democratização. *Avaliação: revista da avaliação da educação superior (Campinas)*, *18*(1), 107-126.

Donsimoni, M. P., Geroski, P., & Jacquemin, A. (1984). Concentration indices and market power: two views. *The Journal of Industrial Economics*, 419-434.

Elzinga, K. G., & Howell, V. M. (2018). Geographic Market Definition in the Merger Guidelines: A Retrospective Analysis. *Review of industrial organization*, *53*(3), 453-475.

Fabra, N., & Motta, M. (2013). Coordinated Effects in Merger Cases. *CRC America Latina*, 1-86.

Façanha, L. O., Resende, M., & Marinho, A. (1997). Brazilian federal universities: relative efficiency evaluation and data envelopment analysis. *Revista Brasileira de Economia*, *51*(4), 489-508.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society: Series A (General)*, *120*(3), 253-281.

Ferreira, P. (2020). Com universidades em colapso, Brasil tem uma das menores taxas de pessoas com ensino superior no mundo. *O Globo*. Accessed 26 March 2020, https://oglobo.globo.com/sociedade/educacao/com-universidades-em-colapso-brasil-tem-uma-das-menores-taxas-de-pessoas-com-ensino-superior-no-mundo-

23936365#:~:text=Com%20universidades%20em%20colapso%2C%20Brasil,no%20mundo%20%2D%20Jornal%20O%20Globo

Fisher, F. M. (1989). Games economists play: a noncooperative view. *The RAND Journal of Economics*, 20(1), 113-124.

Friedman, J. W. (1971). A non-cooperative equilibrium for supergames. *The Review of Economic Studies*, *38*(1), 1-12.

Gideon, A. (2017). *Higher education institutions in the EU: between competition and public service*. TMC Asser Press.

Green, J. (2018). Modeling the In-state Geographic Market Changes of South Dakota Public University Enrollments, 2006 to 2015. *Electronic Theses and Dissertations.* 2431.

Grossman, M., & Kaestner, R. (1997). Effects of education on health. *The social benefits of education*, *12*, 69. Grossman and Kaestner (1997)

Grossman, Michael (2006). Education and non-market outcomes. Chapter 10 in E. Hanushek and F. Welch, eds., *Handbook of the Economics of Education.* Amsterdam: North Holland, pp. 576–33.

Hansmann, H. (2012). The evolving economic structure of higher education. *The University of Chicago Law Review*, *79*(1), 159-183.

Haraguchi, J., & Matsumura, T. (2016). Cournot–Bertrand comparison in a mixed oligopoly. *Journal of Economics*, *117*(2), 117-136.

Hasenclever, L., and Torres, R. (2012). O Modelo Estrutura, Conduta e Desempenho e seus Desdobramentos. In Kupfer, D., Hasenclever, L. (ed.) *Economia industrial: fundamentos teóricos e práticas no Brasil.* Elsevier Brasil, pp. 41-51.

Haveman, R. H., & Wolfe, B. L. (1984). Schooling and economic well-being: The role of nonmarket effects. *Journal of human Resources*, 377-407.

Haveman, R., & Wolfe, B. (2007). Valuing the non-market and social benefits of higher education. *Wider Benefits of Learning Center, Institute of Education, University of London, www. learningbenefits. net*.

Hotelling, H. (1929) Stability in Competition. *Economic Journal*, 39, pp. 41-57.

Hoxby, C. M. (1997). *How the changing market structure of US higher education explains college tuition* (No. w6323). National Bureau of Economic Research.

INEP. (1996) Censo da Educação Superior de 1996. *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira.*

INEP. (2018) Censo da Educação Superior de 2018. *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira.*

Johnes, G. (1992). Performance indicators in higher education: a survey of recent work. *Oxford Review of Economic Policy*, *8*(2), 19-34.

Johnes, J. (2006). Data envelopment analysis and its application to the measurement of efficiency in higher education. *Economics of education review*, *25*(3), 273-288.

Jongbloed, B. (2004). Regulation and competition in higher education. *In Markets in Higer Education* (pp. 87-111). Springer, Dordrecht.

Kaplow, L. (2011). Market definition and the merger guidelines. *Review of Industrial Organization*, *39*(1-2), 107.

Kupfer, D. (1992). Padrões de concorrência e competitividade. *Encontro Nacional da ANPEC*, *20*, 355-372.

Kupfer, D. (2012). Barreiras Estruturais à Entrada. In Kupfer, D., Hasenclever, L. (ed.) *Economia industrial: fundamentos teóricos e práticas no Brasil.* Elsevier Brasil, pp. 79-89.

Lange, F., & Topel, R. (2006). The social value of education and human capital. *Handbook of the Economics of Education*, *1*, 459-509.

Leppel, K. (1993). Logit estimation of a gravity model of the college enrollment decision. *Research in Higher Education*, *34*(3), 387-398.

Lopatka, J. E. (2011). Market definition?. *Review of Industrial Organization*, *39*(1-2), 69-93.

Lopes, H. C. (2016). O modelo estrutura-conduta-desempenho e a teoria evolucionária neoschumpeteriana: uma proposta de integração teórica. *Revista de economia contemporânea*, *20*(2), 336-358.

Losekann, L., Gutierrez, M. (2012). In Kupfer, D., Hasenclever, L. (ed.) *Economia industrial: fundamentos teóricos e práticas no Brasil.* Elsevier Brasil, pp. 67-77.

Malmquist, S. (1953). Index numbers and indifference surfaces. *Trabajos de estadística*, *4*(2), 209-242.

Marginson, S. (2011). Higher education and public good. *Higher education quarterly*, *65*(4), 411-433.

Marques, F. C., da Camara, M. R. G., & de Carvalho, S. C. (2019). Eficiência das instituições de ensino superior públicas e privadas em Administração. *Estudos em Avaliação Educacional*, *30*(75), 910-936.

Mason, E. S. (1939). Price and production policies of large-scale enterprise. *The American economic review*, *29*(1), 61-74.

Massey, P. (2000). Market definition and market power in competition analysis: some practical issues. *Economic and Social Review*, 31(4), 309-328.

Massy, W. F. (2004). Markets in higher education: Do they promote internal efficiency?. *In Markets in Higher Education* (pp. 13-35). Springer, Dordrecht.

Mazzucato, M. (2011). The entrepreneurial state. *Soundings*, *49*(49), 131-142.

McMahon, W. W., & Walter, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. JHU Press.

McMillen, D. P., Singell Jr, L. D., & Waddell, G. R. (2007). Spatial competition and the price of college. *Economic Inquiry*, *45*(4), 817-833.

Monks, J., & Ehrenberg, R. G. (1999). The impact of US News and World Report college rankings on admission outcomes and pricing decisions at selective private institutions (No. w7227). *National Bureau of Economic Research.*

Motta, M., & Salgado, L. (2015). *Política de concorrência: teoria e prática e sua aplicação no Brasil.* Elsevier Brasil.

Nelson, R. R., & Winter, S. G. (1982). The Schumpeterian tradeoff revisited. *The American Economic Review*, 72(1), 114-132.

Nishimori, A., & Ogawa, H. (2002). Public monopoly, mixed oligopoly and productive efficiency. *Australian Economic Papers*, *41*(2), 185-190.

Organisation for Economic Co-operation and Development (OECD). (2019). *Education at a glance 2019: OECD indicators*. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD). (2018). *Education at a glance 2018: OECD indicators*. Paris: OECD.

Pastor, J. T., Ruiz, J. L., & Sirvent, I. (2002). A statistical test for nested radial DEA models. *Operations Research*, *50*(4), 728-735.

Peyerl, D. A., Ferrari, A., & Domingues, M. J. C. D. S. (2019). Eficiência do ensino superior brasileiro: uma avaliação das instituições ofertantes do curso de ciências contábeis.

Polanyi, M. (1958). *Personal knowledge: Towards a post-critical philosophy*. University of Chicago Press.

Quigley, J. M., & Rubinfeld, D. L. (1993). Public choices in public higher education. In Studies of supply and demand in higher education (pp. 243-284). University of Chicago Press.

Ramsey, J. (2001). The Resource Based Perspective, Rents, and Purchasing's Contribution to Sustainable Competitive Advantage. *Journal of Supply Chain Management*. 37(3), pp.38–47.

Resende, M. (1994). Medidas de concentração industrial: uma resenha. *Análise econômica*, *12*(21 and 22).

Resende, M., Boff, H. (2012). Concentração Industrial. In Kupfer, D., Hasenclever, L. (ed.) *Economia industrial: fundamentos teóricos e práticas no Brasil.* Elsevier Brasil, pp. 55-65.

Romer, D. (2012). Advanced macroeconomics. *McGraw Hill Business and Economics,* 4th ed.

Romer, P. M. (1990). Endogenous technological change. *Journal of political Economy*, *98*(5, Part 2), S71-S102.

Romero, L., & Rey, E. D. (2004). Competition between public and private universities: quality, prices and exams.

Rosa, F. N. (2016). A docência na educação superior brasileira: bem público ou educação-mercadoria?. *Revista Brasileira de Ensino Superior*, *2*(3), 58-66.

Salerno, C. (2004). Rapid expansion and extensive deregulation: the development of markets for higher education in the Netherlands. In *Markets in Higer Education* (pp. 271-290). Springer, Dordrecht.

Salop, S. (1979b) Monopolistic Competition with Outside Goods. *Bell Journal of Economics,* 10, pp. 141-156.Salop, S. C. (1979a). Strategic entry deterrence. *The American Economic Review*, *69*(2), 335-338.

Samuelson, P. A. (1954). The pure theory of public expenditure. *The review of economics and statistics*, 387-389.

Santa Cruz, A. C. (2020). Essays on the Industrial Organization of Education Markets (Doctoral dissertation, Columbia University).

Scheffman, D. T., & Spiller, P. T. (1987). Geographic market definition under the US Department of Justice Merger Guidelines. *The Journal of Law and Economics*, *30*(1), 123-147.

Scherer, F. M. (1970) Industrial Market Structure and Economic Performance, Chicago: *Rand McNally & Company.* 2nd Edition.

Schmalensee, R. (1981). Economies of scale and barriers to entry. *Journal of political Economy*, *89*(6), 1228-1238.

Schmalensee, R. (1989). Inter-industry studies of structure and performance. *Handbook of industrial organization*, *2*, 951-1009.

Shaker, G. G., & Plater, W. (2016b). The public good, productivity and purpose: New economic models for higher education. *Retrieved February*, *23*, 2018.

Shaker, G. G., & Plater, W. M. (2016). The global public good: Students, higher education, and communities of good. *Higher Learning Research Communications*, *6*(2), 12.

Shaker, G. G., & Plater, W. M. (2016a). The public good, productivity, and faculty work: Individual effort and social value. *Economics Models Project*.

Shephard, R. W. (1970). *Theory of cost and production functions*. Princeton University Press.

Shepherd WG (1997) The economics of industrial organization: analysis, markets, policies, 4th edn. Prentice Hall, Upper Saddle River, N.J

Shepherd, W. G. (1972). The elements of market structure. *The review of economics and statistics*, 25-37

Shy, O. (1995). *Industrial organization: theory and applications*. MIT press.

Sindicato das Entidades Mantenedoras de Estabelecimentos de Ensino Superior no Estado de São Paulo (SEMESP). (2018). Mapa do Ensino Superior no Brasil.

Statista, (2020). College enrollment in public and private institutions in the U.S. 1965-2029. *Statista*. Accessed 15 April, 2020. https://www.statista.com/statistics/183995/us-college-enrollment-and-projections-in-public-and-private-institutions/

Stiglitz, J. E. (1999). Knowledge as a global public good. *Global public goods: International cooperation in the 21st century*, *308*, 308-325.

Teixeira, P., Jongbloed, B. B., Dill, D. D., & Amaral, A. (Eds.). (2004). *Markets in higher education: rhetoric or reality?* (Vol. 6). Springer Science & Business Media.

Teodorovicz, T., Leandro, T., & Esteves, L. A. (2016). The evolution of a methodology for relevant market definitiion: an analysis of CADE's jurisprudence on private higher educational markets. *Economic Analysis of Law Review*, *6*(2), 246-268.

Tirole, J. (1988). *The theory of industrial organization.* MIT press.

Tone, K. (2004). Malmquist productivity index. In *Handbook on data envelopment analysis* (pp. 203-227). Springer, Boston, MA.

United Nations Educational, Scientific and Cultural Organization. (2015). *Rethinking education: Towards a global common good.* Paris, France.

United States Department of Justice and Federal Trade Commission. (2010). Horizontal merger guidelines. Washington D.C: *DoJ and FTC*.

Weisbrod, B. A., Ballou, J. P., & Asch, E. D. (2008). Mission and money: Understanding the university. Cambridge University Press.

Willetts, D. (2015) Issues and ideas on higher education: Who benefits? Who pays? London. *The Policy Institute at King's College London.–2015.–51 p*.

Williams, G. (2016). Higher education: Public good or private commodity?. *London Review of Education*, 14(1), 131-142.

Winston, G. C., & McPherson, M. S. (1991). The Economics of Cost, Price and Quality in US Higher Education. *Williams Project of Higher Education*.

Wolfe, B. L., & Haveman, R. H. (2001). *Accounting for the social and non-market benefits of education* (pp. 97-131). Institute for Research on Poverty, University of Wisconsin-Madison.

Wolfe, B., & Zuvekas, S. (1997). Non-market effects of education. *International Journal of Education Research*, *27*(6), 491-502.

Wolfe, Barbara L., and R. H. Haveman (2003). Social and non-market benefits from education in an advanced economy. In Yolanda Kodrzycki, ed., *Education in the 21st Century: Meeting the Challenges of a Changing World*. Boston: Federal Reserve Bank.

APPENDIX

Table 7 - Market 4: Southeast Market IGC = 4 & 5 (continues)

Institution	*Ownership*	*State*	*Students*	*Market Share*
UNINOVE	Private	SP	154.804	14,10%
USP	Public	SP	59.084	5,38%
UFRJ	Public	RJ	50.519	4,60%
PUC MINAS	Private	MG	50.472	4,60%
UFF	Public	RJ	46.705	4,25%
UNESP	Public	SP	41.093	3,74%
UFMG	Public	MG	35.814	3,26%
MACKENZIE SP	Private	SP	33.354	3,04%
UERJ	Public	RJ	33.208	3,02%
UFES	Public	ES	24.583	2,24%
UFU	Public	MG	22.363	2,04%
UFJF	Public	MG	20.353	1,85%
Unicamp	Public	SP	19.672	1,79%
UNOESTE	Private	SP	19.519	1,78%
UFRRJ	Public	RJ	17.959	1,64%
UNICARIOCA	Private	RJ	16.944	1,54%
PUC-Rio	Private	RJ	16.444	1,50%
UFABC	Public	SP	15.888	1,45%
PUCSP	Private	SP	15.218	1,39%
UFV	Public	MG	15.165	1,38%
UFSCAR	Public	SP	14.116	1,29%
UFOP	Public	MG	13.330	1,21%
UFSJ	Public	MG	13.104	1,19%
UVV	Private	ES	12.963	1,18%
UNIFESP	Public	SP	12.095	1,10%
UNIRIO	Public	RJ	11.706	1,07%
UNIARARAS	Private	SP	11.745	1,07%
UFLA	Public	MG	11.111	1,01%
IFSP	Public	SP	10.172	0,93%
UFVJM	Public	MG	10.246	0,93%
UNAERP	Private	SP	9.725	0,89%
UNIFENAS	Private	MG	9.582	0,87%
UNISALESIANO	Private	SP	8.980	0,82%
FEI	Private	SP	8.894	0,81%
UNISANTA	Private	SP	8.073	0,74%
UNIFEI	Public	MG	7.986	0,73%
CEFET/RJ	Public	RJ	7.879	0,72%
UFTM	Public	MG	7.332	0,67%
UNIFAL-MG	Public	MG	6.983	0,64%
UNIFOA	Private	RJ	6.956	0,63%
IFES	Public	ES	6.865	0,63%

Table 7 - Market 4: Southeast Market IGC = 4 & 5 (continues)

UNILESTEMG	Private	MG	6.057	0,55%
CEFET/MG	Public	MG	5.949	0,54%
FACREDENTOR	Private	RJ	5.675	0,52%
USC	Private	SP	5.674	0,52%
FAESA	Private	ES	5.283	0,48%
UNISANTOS	Private	SP	5.194	0,47%
ESPM	Private	SP	5.073	0,46%
FACENS	Private	SP	5.057	0,46%
UNIFEOB	Private	SP	4.807	0,44%
UNESC	Private	ES	4.871	0,44%
IFRJ	Public	RJ	4.481	0,41%
FAFIBE	Private	SP	4.538	0,41%
IF SUL DE MINAS	Public	MG	4.385	0,40%
CEUN-IMT	Private	SP	4.291	0,39%
CENTRO UNIVERSITÁRIO CATÓLICO DE VITÓRIA	Private	ES	4.286	0,39%
UNIS-MG	Private	MG	4.024	0,37%
FSJ	Private	RJ	3.824	0,35%
FECAP	Private	SP	3.754	0,34%
TOLEDO PRUDENTE	Private	SP	3.247	0,30%
UNIARAXÁ	Private	MG	3.313	0,30%
ESDHC	Private	MG	3.309	0,30%
CESVA	Private	RJ	3.231	0,29%
FGV SP	Private	SP	3.149	0,29%
UNIFAE	Private	SP	2.941	0,27%
FIO	Private	SP	2.953	0,27%
Insper	Private	SP	2.699	0,25%
FAESA	Private	ES	2.604	0,24%
MACKENZIE RJ	Private	RJ	2.464	0,22%
FMABC	Private	SP	2.432	0,22%
Centro Universitário de Bauru	Private	SP	2.436	0,22%
UENF	Public	RJ	2.158	0,20%
UNI-FACEF	Private	SP	2.186	0,20%
DOCTUM	Private	ES	2.212	0,20%
CENTRO UNIVERSITÁRIO PADRE ALBINO	Private	SP	2.138	0,19%
UNIVEM	Private	SP	2.027	0,18%
DOCTUM	Private	MG	1.927	0,18%
DOCTUM	Private	ES	1.984	0,18%
ESPM RJ	Private	RJ	1.895	0,17%
EDUVALE	Private	SP	1.889	0,17%
EMESCAM	Private	ES	1.737	0,16%
FASE	Private	RJ	1.512	0,14%
CEUCLAR	Private	SP	1.560	0,14%
FACCSR	Private	SP	1.545	0,14%
INATEL	Private	MG	1.508	0,14%

Table 7 - Market 4: Southeast Market IGC = 4 & 5 (continues)

FAPAM	Private	MG	1.435	0,13%
FAPCOM	Private	SP	1.372	0,12%
FDSM	Private	MG	1.350	0,12%
FAMA	Private	MG	1.283	0,12%
UEZO	Public	RJ	1.065	0,10%
FACREDENTOR/Campos	Private	RJ	1.048	0,10%
FMCMSCSP	Private	SP	1.079	0,10%
STRONG	Private	SP	1.052	0,10%
FTT	Private	SP	1.149	0,10%
FGV RJ	Private	RJ	982	0,09%
FCM	Private	MG	995	0,09%
FCGD	Private	SP	906	0,08%
ITA	Public	SP	814	0,07%
FAC-FEA	Public	SP	808	0,07%
ISESP	Private	SP	795	0,07%
FAMERP	Public	SP	683	0,06%
FAMEMA	Public	SP	642	0,06%
FCE	Private	SP	713	0,06%
FACAP	Private	SP	609	0,06%
DOCTUM	Private	ES	645	0,06%
FERLAGOS	Private	RJ	603	0,05%
FMJ	Public	SP	594	0,05%
FICSAE	Private	SP	602	0,05%
FAESSA	Private	MG	571	0,05%
FIC	Private	MG	552	0,05%
ESP	Private	SP	439	0,04%
FUL	Private	MG	478	0,04%
Faculdade Presidente Antônio Carlos de Ponte Nova	Private	MG	444	0,04%
FATEP	Private	MG	432	0,04%
IME	Public	RJ	297	0,03%
FSB/RJ	Private	RJ	307	0,03%
FSB	Private	SP	354	0,03%
FANS	Private	MG	367	0,03%
ISTA	Private	MG	282	0,03%
DOCTUM	Private	MG	355	0,03%
FENORD	Private	MG	360	0,03%
DOCTUM	Private	ES	342	0,03%
UNICAPE	Private	ES	361	0,03%
ESNS	Private	RJ	218	0,02%
FAPSS	Private	SP	205	0,02%
FTBSP	Private	SP	252	0,02%
SRONG/Santos	Private	SP	224	0,02%
ITESP	Private	SP	177	0,02%
ESNS-SP	Private	SP	270	0,02%
FRB-GV	Private	SP	222	0,02%

Table 7 - Market 4: Southeast Market IGC = 4 & 5 (ends)

FIPECAFI	Private	SP	245	0,02%
FCI	Private	SP	186	0,02%
EG	Public	MG	268	0,02%
FUC	Private	MG	256	0,02%
EEFTESM	Private	RJ	119	0,01%
ISECENSA	Private	RJ	123	0,01%
ITF	Private	RJ	70	0,01%
FATEC	Private	RJ	85	0,01%
FACEPD	Private	SP	151	0,01%
FFIA	Private	SP	143	0,01%
FJB	Private	SP	155	0,01%
FATIPI	Private	SP	60	0,01%
FACAPA	Private	MG	104	0,01%
FACESGRANRIO	Private	RJ	37	0,00%
ISE VERA CRUZ	Private	SP	47	0,00%
Total			1.098.065	100,00%
Private Sector			540.590	49,23%
Public Sector			557.475	50,77%
CR4				28,68%
CR8				42,97%
HHI				386,62

Source: elaboration by the author based on data by INEP (2018).

Table 13 - Southeaster Public Market Admissions (continues)

HEI	Ind.	ENEM	Independent Admissions
UFOP	0,9%	88,7%	Uses only ENEM.
UFSCAR	2,7%	86,8%	Uses only ENEM.
UFV	5,7%	73,4%	Uses only ENEM.
UFU	37,2%	44,9%	Two phases, both with all general subjects from high school. First is a multiple choice (MC), objective exam, and the second is a discursive exam.
Unicamp	88,3%	0,0%	Only independent admissions. First phase is a MC, general high school knowledge test. Second phase has one general exam and one according to the area of knowledge of the student's chosen course.
UNESP	93,7%	0,0%	Only independent admissions. First phase is a general knowledge MC test and second phase is a MC test for the specific area of knowledge.
UFSJ	14,8%	72,6%	Used the independent, serial test model for students in each year of high school. Program was terminated in 2015.
FAMERP	94,0%	0,0%	Only independent admissions.
FAMEMA	99,1%	0,0%	Only independent admissions.
UERJ	94,7%	0,0%	Only independent admissions. First phase is a general knowledge MC test in which students are given a rating from E to A, which grants them extra points for the second phase. Second phase is a specific, discursive test.
UFPR	75,0%	15,0%	First phase is a MC objective test, qualifying for the second phase, which is a discursive, general and specific knowledge exam.
UFF	7,6%	80,6%	Uses only ENEM.
UFES	51,0%	86,8%	Uses ENEM as the first phase, then applies an independent, MC objective test as the second phase. From 2019 on, starts using only ENEM.
UFRRJ	74,0%	19,7%	Uses only ENEM, but assigns different weights to each subject according to the course chosen by the student. Therefore, data counts as an independent exam.
UFMG	24,1%	67,9%	Uses only ENEM.
UFJF	10,2%	52,3%	Uses the independent, serial test model for students in each year of high school. Also uses ENEM.
UFRGS	66,0%	12,7%	Uses only one phase, consisting of a MC test of high school subjects.
UFSC	73,8%	13,8%	Uses only one phase, consisting of a MC test of high school subjects.
UFRJ	88,7%	2,2%	Uses only ENEM, but assigns different weights to each subject according to the course chosen by the student. Therefore, data counts as an independent exam.
UNIFESP	15,8%	65,4%	Uses a mixed system for some courses, but employs mainly ENEM.

Table 13 - Southeaster Public Market Admissions (ends)

UFLA	0,2%	67,7%	Used the independent, serial test model for students in the first two years of high school. Then, uses ENEM as the third score.
CEFET/RJ	5,4%	82,9%	Uses only ENEM.
CEFET/MG	32,8%	57,4%	MC specific tests and ENEM.
UNIFAL	0,1%	85,6%	Uses only ENEM.
UFVJM	2,3%	65,2%	Uses only ENEM.
UFTM	14,4%	68,3%	Uses only ENEM.
UNIFEI	45,4%	46,7%	Applies a MC test for the subjects of mathematics, physics, and chemistry.
ITA	69,9%	0,0%	Uses only independent admissions. First phase consists of a MC test for exact sciences, as well as Portuguese and English. Second phase is a discursive test for the same subjects.
IME	65,7%	0,0%	Uses only independent admissions. First phase is a MC test only for exact sciences. Second phase consists of a discursive exam for exact sciences, as well as Portuguese and English.
UNIRIO	0,8%	90,7%	Uses only ENEM.
UFCSPA	0,0%	90,4%	Uses only ENEM.
UENF	2,0%	93,7%	Uses only ENEM.
IFES	4,8%	79,7%	Uses only ENEM.
IFSP	5,7%	84,9%	Uses only ENEM.
IFRJ	1,9%	93,2%	Uses only ENEM.
UFABC	0,2%	61,1%	Uses only ENEM.
UEZO	31,1%	52,3%	First phase is a MC objective test, second phase is a discursive test.
USP	75,4%	24,6%	First phase is a general knowledge MC test. Second phase is a discursive test, consisting of Portuguese and subjects relating to the course chosen by the student.

Source: elaboration by the author based on data from INEP (2018).[57]

[57] The percentages were calculated with data from the Higher Education Census of 2018, and the descriptions of the selection processes were taken from each institution's website.

Table 14 - HEI-Specific Funding Programs (continues)

Institution	Students	Funding
UNIARARAS	11.745	102,5%
FRB-GV	222	93,2%
EDUVALE	1.889	88,6%
ISECENSA	123	84,6%
FACESGRANRIO	37	75,7%
Faculdade Presidente Antônio Carlos de Ponte Nova	444	66,7%
FAFIBE	4.538	60,6%
FUC	256	56,6%
FERLAGOS	603	55,4%
FATEP	432	55,3%
FUL	478	55,2%
CESVA	3.231	55,1%
FCM	995	50,5%
UNIS-MG	4.024	50,0%
FGV DIREITO RIO	354	49,7%
FIC	552	47,1%
FASE	1.512	46,9%
DOCTUM	2.212	45,6%
ISE VERA CRUZ	47	44,7%
FIO	2.953	43,6%
DOCTUM	342	43,0%
DOCTUM	645	41,1%
INATEL	1.508	40,1%
FAPCOM	1.372	40,1%
DOCTUM	1.927	39,2%
FCGD	906	38,7%
DOCTUM	1.984	38,1%
Centro Universitário de Bauru	2.436	36,9%
FGV DIREITO SP	365	36,2%
FGV EBEF	233	35,6%
EMESCAM	1.737	31,5%
UNAERP	9.725	31,1%
PUC MINAS	50.472	30,4%
EESP	181	29,8%
PUC-Rio	16.444	29,2%
ESDHC	3.309	29,1%
FMABC	2.432	28,5%
FDSM	1.350	27,0%
UNIARAXÁ	3.313	26,9%
FCI	186	25,8%
UNISANTA	8.073	25,5%
DOCTUM	355	25,4%
FCMSCSP	1.079	24,3%
MACKENZIE SP	33.354	24,1%

Table 14 - HEI-Specific Funding Programs (continues)

FGV Rio	982	23,6%
UNIVEM	2.027	23,4%
FENORD	360	21,9%
FACENS	5.057	21,7%
FGV-EASP	2.603	21,4%
FGV SP	3.149	21,4%
FGV EBAPE	235	21,3%
CEUN-IMT	4.291	20,7%
UNINOVE	154.804	19,3%
UNIFENAS	9.582	19,2%
ESPM	5.073	18,8%
FICSAE	602	18,1%
CENTRO UNIVERSITÁRIO PADRE ALBINO	2.138	17,4%
FACCSR	1.545	15,5%
FAMA	1.283	14,0%
CENTRO UNIVERSITÁRIO CATÓLICO DE VITÓRIA	4.286	13,8%
PUCSP	15.218	12,6%
UNESC	4.871	12,6%
FFIA	143	11,2%
FACAPA	104	10,6%
CEUCLAR	1.560	10,1%
UNISALESIANO	8.980	9,5%
FEI	8.894	7,0%
MACKENZIE RJ	2.464	6,9%
FECAP	3.754	5,1%
UNILESTEMG	6.057	5,1%
UNOESTE	19.519	4,0%
USC	5.674	3,4%
FANS	367	3,3%
UNISANTOS	5.194	2,9%
FAPAM	1.435	0,6%
ESPM RJ	1.895	0,2%
UNI-FACEF	2.186	0,0%
EEFTESM	119	0,0%
UNIFAE	2.941	0,0%
FAESA	2.604	0,0%
FAPSS	205	0,0%
ESP	439	0,0%
UNIFOA	6.956	0,0%
UVV	12.963	0,0%
FSJ	3.824	0,0%
UNICARIOCA	16.944	0,0%
FAJE	228	0,0%
FACEPD	151	0,0%
FCE	713	0,0%

Table 14 - HEI-Specific Funding Programs (ends)

Insper	2.699	0,0%
FAESA	5.283	0,0%
EST	240	0,0%
STRONG	1.052	0,0%
FJB	155	0,0%
UNICAPE	361	0,0%
UNIFEOB	4.807	0,0%
TOLEDO PRUDENTE	3.247	0,0%
FSB	354	0,0%
ISESP	795	0,0%
ISTA	282	0,0%
FUCAPE	427	0,0%
ITF	70	0,0%
FACREDENTOR	5.675	0,0%
FSB/RJ	307	0,0%
FTT	1.149	0,0%
FATEC	85	0,0%
FAESSA	571	0,0%
FGV CS	85	0,0%
ESNS	218	0,0%
SOCIESC	662	0,0%
FTBSP	252	0,0%
FCRN	808	0,0%
SRONG/Santos	224	0,0%
FATIPI	60	0,0%
ITESP	177	0,0%
ESNS-SP	270	0,0%
FCC	92	0,0%
ESCOLA DE MATEMÁTICA APLICADA	75	0,0%
FACREDENTOR/Campos	1.048	0,0%
FIPECAFI	245	0,0%
FACAP	609	0,0%

Source: elaboration by the author based on data from INEP (2018).

Table 15 - Descriptive Statistics for Chosen Inputs and Outputs

Parameter	***STUD***	***ST_COMP***	***PUB_SC***
Mean	7.797,90	958,10	397,30
SD	16.544,39	1.976,74	1.538,40
Max	154.804,00	17.816,00	15.282,00
Min	47,00	1,00	0,00
Parameter	***PATENT***	***FACUTY***	***PHD***
Mean	2,89	509,26	361,09
SD	9,27	913,60	804,83
Max	62,00	6.088,00	6.008,00
Min	0,00	6,00	0,00
Parameter	***MA***	***TEC***	***EX_FAC***
Mean	116,52	699,06	97.469.274,35
SD	186,52	1.685,76	212.090.520,93
Max	1.181,00	14.581,00	1.392.230.229,00
Min	0,00	3,00	1,00
Parameter	***EX_TEC***	***EX_GEN***	***EX_INV***
Mean	51.809.702,97	56.976.676,73	10.642.350,02
SD	168.656.230,98	131.632.485,91	32.111.706,60
Max	1.455.179.507,00	1.089.051.591,00	260.708.956,40
Min			
Parameter	***EX_RES***	***EX_OTH***	
Mean	3.643.402,73	33.756.070,24	
SD	16.540.346,38	108.867.664,02	
Max	175.341.628,00	929.841.545,20	
Min	0,00	0,00	

Source: elaboration by the author based on data from INEP (2018), INPI (2018), and Web of Science (2018).

Table 16 - Model 1 Efficiency Scores (continues)

HEI	*Ownership*	*EFF-CRS*	*EFF-VRS*
UFOP	Public	1,00	1,00
UFSCAR	Public	1,00	1,00
UFV	Public	1,00	1,00
UFU	Public	1,00	1,00
MACKENZIE SP	Private	1,00	1,00
Unicamp	Public	1,00	1,00
USP	Public	1,00	1,00
UNESP	Public	1,00	1,00
UFSJ	Public	1,00	1,00
INATEL	Private	1,00	1,00
CEUCLAR	Private	1,00	1,00
USC	Private	1,00	1,00
FAMERP	Public	1,00	1,00
FDSM	Private	1,00	1,00
MACKENZIE RJ	Private	1,00	1,00
FMABC	Private	1,00	1,00
FIO	Private	1,00	1,00
UNINOVE	Private	1,00	1,00
PUC MINAS	Private	1,00	1,00
FAPSS	Private	1,00	1,00
ESP	Private	1,00	1,00
UNIFOA	Private	1,00	1,00
EMESCAM	Private	1,00	1,00
UFF	Public	1,00	1,00
UFRRJ	Public	1,00	1,00
UFMG	Public	1,00	1,00
UNIFESP	Public	1,00	1,00
UFLA	Public	1,00	1,00
UNIFAL-MG	Public	1,00	1,00
UFVJM	Public	1,00	1,00
UNIFEI	Public	1,00	1,00
ITA	Public	1,00	1,00
IME	Public	1,00	1,00
UVV	Private	1,00	1,00
FSJ	Private	1,00	1,00
FAPAM	Private	1,00	1,00
UNILESTEMG	Private	1,00	1,00
EG	Public	1,00	1,00
FCGD	Private	1,00	1,00
FACCSR	Private	1,00	1,00
UNISANTA	Private	1,00	1,00
UENF	Public	1,00	1,00
DOCTUM	Private	1,00	1,00
Insper	Private	1,00	1,00
DOCTUM	Private	1,00	1,00
EDUVALE	Private	1,00	1,00
FAESA	Private	1,00	1,00

Table 16 - Model 1 Efficiency Scores (continues)

Centro Universitário Católico de Vitória	Private	1,00	1,00
FFIA	Private	1,00	1,00
STRONG	Private	1,00	1,00
UNICAPE	Private	1,00	1,00
IFES	Public	1,00	1,00
UNIFEOB	Private	1,00	1,00
FAJANSSEN	Private	1,00	1,00
ISESP	Private	1,00	1,00
FANS	Private	1,00	1,00
ISECENSA	Private	1,00	1,00
ISTA	Private	1,00	1,00
FSB/RJ	Private	1,00	1,00
FAFIBE	Private	1,00	1,00
UNIVEM	Private	1,00	1,00
ESNS	Private	1,00	1,00
FTBSP	Private	1,00	1,00
UFABC	Public	1,00	1,00
UEZO	Public	1,00	1,00
FATIPI	Private	1,00	1,00
Centro Universitário Padre Albino	Private	1,00	1,00
DOCTUM	Private	1,00	1,00
DOCTUM	Private	1,00	1,00
FENORD	Private	1,00	1,00
ITESP	Private	1,00	1,00
FRB-GV	Private	1,00	1,00
Faculdade Presidente Antônio Carlos de Ponte Nova	Private	1,00	1,00
Centro Universitário Uma de Bom Despacho	Private	1,00	1,00
FACAP	Private	1,00	1,00
UNICARIOCA	Private	0,99	1,00
FAMA	Private	0,99	1,00
FAMEMA	Public	0,97	1,00
SRONG/Santos	Private	0,96	1,00
IF SUL DE MINAS	Public	0,95	0,95
FCM	Private	0,93	0,94
FECAP	Private	0,90	1,00
FJB	Private	0,89	1,00
DOCTUM	Private	0,87	0,88
FAESSA	Private	0,87	0,92
ESPM	Private	0,85	0,85
UNISALESIANO	Private	0,84	0,97
FATEP	Private	0,83	0,85
Centro Universitário de Bauru	Private	0,81	0,91
FIPECAFI	Private	0,81	0,90
FAPCOM	Private	0,80	0,88
UNESC	Private	0,78	0,97
CEFET/RJ	Public	0,77	1,00
FAC-FEA	Public	0,77	0,81

Table 16 - Model 1 Efficiency Scores (continues)

FGV	Private	0,76	0,78
FEI	Private	0,75	0,85
PUC-Rio	Private	0,74	0,90
FCE	Private	0,74	1,00
CEUN-IMT	Private	0,73	0,74
UNIARAXÁ	Private	0,72	0,75
FACAPA	Private	0,72	1,00
FUL	Private	0,70	0,73
UNAERP	Private	0,69	0,88
FACULDADE FUCAPE	Private	0,69	0,76
UNISANTOS	Private	0,68	0,78
UNOESTE	Private	0,68	0,91
UFJF	Public	0,67	0,83
UNIFENAS	Private	0,66	0,80
UNIRIO	Public	0,66	0,69
UFES	Public	0,65	0,83
EEFTESM	Private	0,63	1,00
PUCSP	Private	0,63	0,89
TOLEDO PRUDENTE	Private	0,62	0,64
FIC	Private	0,62	0,64
UNIS-MG	Private	0,61	0,72
CEFET/MG	Public	0,60	0,61
UFRJ	Public	0,57	0,74
UFTM	Public	0,57	0,57
DOCTUM	Private	0,57	0,67
FACEPD	Private	0,56	0,75
UNIARARAS	Private	0,56	0,68
ESDHC	Private	0,56	0,56
UERJ	Public	0,52	0,69
ESPM RJ	Private	0,51	0,55
FMCMSCSP	Private	0,50	0,61
IFRJ	Public	0,48	1,00
FAESA	Private	0,47	0,52
ESNS-SP	Private	0,45	0,67
CESVA	Private	0,43	0,48
FSB	Private	0,43	0,59
FACREDENTOR	Private	0,43	0,49
FICSAE	Private	0,42	0,48
FASE	Private	0,42	0,50
FCI	Private	0,32	1,00
FACREDENTOR/Campos	Private	0,27	0,29
Faculdade de Administração de Cataguases	Private	0,25	1,00
FUC	Private	0,24	0,45
ISE VERA CRUZ	Private	0,23	1,00
IFSP	Public	0,15	0,24
FACENS	Private	0,12	0,12
FTT	Private	0,06	0,06
Average Score	-	0,83	0,89

Table 16 - Model 1 Efficiency Scores (ends)

Average Score Private HEIs	Private	0,81	0,88
Average Score Public HEIs	Public	0,87	0,92

Source: elaboration by the author based on data from INEP (2018), INPI (2018), and Web of Science (2018).

Table 17 - Model 2 Efficiency Scores

HEI	*EFF-CRS*	*EFF-VRS*
UFOP	1,00	1,00
UFSCAR	1,00	1,00
UFV	1,00	1,00
UFU	1,00	1,00
Unicamp	1,00	1,00
USP	1,00	1,00
UNESP	1,00	1,00
UFSJ	1,00	1,00
FAMERP	1,00	1,00
UFF	1,00	1,00
UFRRJ	1,00	1,00
UFMG	1,00	1,00
UNIFESP	1,00	1,00
UFLA	1,00	1,00
UNIFAL-MG	1,00	1,00
UFVJM	1,00	1,00
UNIFEI	1,00	1,00
ITA	1,00	1,00
IME	1,00	1,00
FAC-FEA	1,00	1,00
EG	1,00	1,00
UENF	1,00	1,00
IFES	1,00	1,00
IF SUL DE MINAS	1,00	1,00
UFABC	1,00	1,00
UEZO	1,00	1,00
FAMEMA	0,97	1,00
UFJF	0,95	1,00
CEFET/RJ	0,77	1,00
UFES	0,76	0,98
UFRJ	0,72	0,91
UERJ	0,68	0,97
UNIRIO	0,67	0,84
CEFET/MG	0,63	0,65
UFTM	0,63	0,80
IFRJ	0,48	1,00
IFSP	0,16	0,30
Average	0,90	0,96

Source: elaboration by the author based on data from INEP (2018), INPI (2018), and Web of Science (2018).

Table 18 - Model 3 Efficiency Scores (continues)

HEI	*EFF-CRS*	*EFF-VRS*
FGV	0,77	0,80
MACKENZIE SP	1,00	1,00
UNIFENAS	0,78	0,82
INATEL	1,00	1,00
CEUCLAR	1,00	1,00
USC	1,00	1,00
FDSM	1,00	1,00
EEFTESM	0,76	1,00
MACKENZIE RJ	1,00	1,00
UNAERP	0,76	1,00
FECAP	0,90	1,00
FMABC	1,00	1,00
UNISANTOS	0,80	0,81
FIO	1,00	1,00
FAESA	0,47	0,52
UNOESTE	0,96	0,97
UNINOVE	1,00	1,00
PUC MINAS	1,00	1,00
FAPSS	1,00	1,00
ESP	1,00	1,00
FMCMSCSP	0,55	0,63
UNIFOA	1,00	1,00
CESVA	0,43	0,48
EMESCAM	1,00	1,00
PUC-Rio	1,00	1,00
PUCSP	1,00	1,00
ESPM	0,93	0,98
UVV	1,00	1,00
FACENS	0,12	0,12
FSJ	1,00	1,00
FAPAM	1,00	1,00
FICSAE	1,00	1,00
UNICARIOCA	0,99	1,00
UNILESTEMG	1,00	1,00
FACEPD	0,81	1,00
FCGD	1,00	1,00
FACCSR	1,00	1,00
ESPM RJ	0,51	0,56
UNISANTA	1,00	1,00
Centro Universitário de Bauru	0,83	0,93
UNIARARAS	0,62	0,69
FCE	0,97	1,00
DOCTUM	0,58	0,67
DOCTUM	1,00	1,00

Table 18 - Model 3 Efficiency Scores (continues)

FAMA	0,99	1,00
FASE	0,45	0,51
Insper	1,00	1,00
DOCTUM	1,00	1,00
EDUVALE	1,00	1,00
FAESA	1,00	1,00
CEUN-IMT	0,73	0,74
Centro Universitário Católico de Vitória	1,00	1,00
FFIA	1,00	1,00
DOCTUM	0,87	0,88
UNESC	0,78	0,97
UNIARAXÁ	0,73	0,77
STRONG	1,00	1,00
FJB	0,89	1,00
UNICAPE	1,00	1,00
UNIFEOB	1,00	1,00
TOLEDO PRUDENTE	0,62	0,64
FEI	0,79	0,93
FSB	0,81	1,00
FAJANSSEN	1,00	1,00
Faculdade de Administração de Cataguases	0,25	1,00
ISESP	1,00	1,00
FANS	1,00	1,00
ISECENSA	1,00	1,00
ISTA	1,00	1,00
FCM	0,93	0,94
FACULDADE FUCAPE	1,00	1,00
FACREDENTOR	0,43	0,49
FSB/RJ	1,00	1,00
ISE VERA CRUZ	0,24	1,00
FAFIBE	1,00	1,00
FAPCOM	0,80	0,88
ESDHC	0,72	0,74
FTT	0,12	0,13
UNIS-MG	0,61	0,72
FAESSA	0,88	0,93
FACAPA	0,84	1,00
UNIVEM	1,00	1,00
ESNS	1,00	1,00
FTBSP	1,00	1,00
FIC	0,62	0,64
UNISALESIANO	0,84	0,97
SRONG/Santos	0,96	1,00
FATIPI	1,00	1,00
Centro Universitário Padre Albino	1,00	1,00

Table 18 - Model 3 Efficiency Scores (ends)

DOCTUM	1,00	1,00
FUC	0,24	0,45
DOCTUM	1,00	1,00
FUL	0,70	0,73
FENORD	1,00	1,00
ITESP	1,00	1,00
ESNS-SP	0,45	0,67
FRB-GV	1,00	1,00
FUPAC Ponte Nova	1,00	1,00
FATEP	0,84	0,86
FACREDENTOR/Campos	0,27	0,30
FIPECAFI	0,93	0,99
UNA Bom Despacho	1,00	1,00
FACAP	1,00	1,00
FCI	0,32	1,00
Average	0,85	0,90

Source: elaboration by the author.